THURSDAY, JUNE 17, 1915.

THE MOBILISATION OF SCIENCE

IN a letter to the *Times* of June 11 Mr. H. G. Wells gives utterance to a plea which, unheeded in days of peace, may awaken a sympathetic response while the stress of war is upon the nation. In asking that faith in the man behind the gun shall not be made any longer an excuse for providing him with fewer or inferior weapons, he invites political leaders and the War Office to make the fullest use of scientific men and method in the conduct of the war. He asks for the appointment of an acting sub-Government of scientific and technically competent men which will organise our utmost resources of scientific knowledge and promote the employment of the most effective means of dealing with the enemy.

There are signs that things are moving in the direction which Mr. Wells indicates as the road along which triumph must be assured, and his letter should hasten the organisation of the scientific forces which will assist to this end. The publication of the total number of casualties during the last ten months ought to convince the nation that this war is one in which we cannot afford to give odds; and that all the force of scientific ingenuity and scientific organisation must be concentrated upon the military and naval operations. There are hundreds of men of science in the country whose energies and expert knowledge are not being effectively used. We should possess a scientific corps, with men investigating at the Front as well as at home, instead of one or two committees advising officials as to possible means of offence or defence. When a man of science of such distinguished eminence as Prof. J. A. Fleming can say, as he does in the *Times* of June 15, that after ten months of scientific warfare he has never been asked to co-operate in any experimental work or place any of his expert knowledge at the disposal of the forces of the Crown, though he is anxious to give such assistance, it is evident that the people in authority cannot understand the value of the scientific forces which it cheerfully neglects. Not a day passes but we are asked by men of science how they can devote their knowledge to national needs; and there is no ready answer. The organisation of the scientific intellect of the country is essential, yet almost nothing has yet been done towards its accomplishment.

It seems necessary, in considering how national needs may be met, to separate the invention of new methods of offence or defence from an increase in the supply of high explosive shell which has loomed so large in the newspapers. The novelty of the conditions and the unconventionality of the methods employed in this war carry the first problem outside the grooves in which naval and military engineers have hitherto worked; and the united efforts of civilians and Service men will be required for its solution. The necessity has arisen for surveying the whole scientific field to discover methods of destruction which we may use ourselves or from which our men look to us for protection. It is not enough that the Government should call in a scientific expert to advise in respect of what has occurred; they must be ready to meet it when it does occur. Moreover, such intelligent anticipation ought not to be the special property of one department, and departmental rivalry or indifference ought to be smothered at birth by the appointment of a National Committee with a free hand and ample funds for experimental work.

Such an arrangement is the more necessary in order to prevent the diffusion of effort over too wide a field. Some men are already engaged upon investigations of first-rate importance and yet unconnected either with industry or war; and others are doing work upon which the maintenance of trade depends. It should be possible to secure a sufficient number of men of adequate standing without encroaching in any way upon those we have mentioned. For the war will bring its aftermath of international competition, and we might as well lose as neglect to prepare for it. We plead, therefore, with Mr. Wells for a central organisation which shall direct into the most useful channels that mass of scientific knowledge and skill which is only waiting to serve the country's need.

But valuable as the work of such a committee might be, it would not obviate the desirability of using technically trained men to a far greater extent than is at present attempted, in increasing the output of the ordinary munitions of war. The problem before the new Minister is a dual one, and the two factors are labour and organisation. No man can do more than Mr. Lloyd George in persuading the workmen as a body to recognise the importance of unity and the danger which arises from industrial disputes; and every speech he delivers is both an inspiration and a warning. But it remains to be seen how far he will be able to secure that smoothness and efficiency of

administration that is so completely the need of the hour.

The intention of the Minister has been pretty clearly expressed. Production is to be speeded up by using at first the most perfectly equipped shops, and by drawing labour and machines from those less fully qualified to undertake the work. It is to be hoped that an effort will be made to work three shifts in the twenty-four hours. There seems to be no reason why the students in the scientific and technological faculties of the universities and older boys in public schools should not be mobilised for this purpose. The greater number of jobs are carried out on automatic machines, the control of which can be learnt in a fortnight or less. The main object, however, is that the most efficient and economical methods of production must be adopted; the small shop, therefore, must stand out; and the individual must express his patriotism in co-operative effort.

Not a great deal of consolation is to be derived from the administration of local committees constituted by a careful balancing of interests and "municipalised" by the presence of the chief magistrate. If the local employers, managers, or foremen are giving the most effective service in their own works they will have little time for attending committees. A committee is as effective in affording opportunity for personal differences as it is for securing unanimity as to method and aim. The more such bodies are used in an advisory, and the less they are used in an executive capacity, the happier will be the result of their efforts. For getting things done one autocrat is worth twenty committees, provided that he has common sense and is neither a politician nor a lawyer who regulates action by precedent.

The work of organising our scientific and technical forces should not be put into the hands of men whose knowledge is limited to the etymological derivation of the names of things required—at least not in time of war, and it is imperative to consider whether the real resources of technically trained men have been tapped. A great many have entered the army and have been drafted into regiments where their specialised knowledge is of little use. Even then the fact that they can write has resulted in their being burdened with clerical work, which could as easily be done by women. But there are many men who for more or less adequate reasons are not in uniform and are only awaiting the call to industrial service. In comparison with previous wars the present conflict is not a war of men so much as a war of guns and ammunition, and if we are to hasten that end which we believe to be inevitable, we must concentrate every element of scientific knowledge and technical skill into its prosecution.

Scientific discovery, mechanical invention, and a highly technical organisation as employed by the Germans are only to be beaten by similar forces arrayed against them. It is not a time to say what ought to have been in the past, but what should be now and in the immediate future. We know that up to a certain point the scientific resources of the country have been drawn upon, but beyond the fact that one man is working at explosives, another at the Royal Aircraft Factory, and a third is testing for the Admiralty, we want to feel that these are only details of a wider scheme so perfect in its organisation that the full effect of our forty-five millions of people is brought to bear upon the enemy. Many people would sleep more peacefully if they knew that every technically trained man in the universities, university colleges, technical institutions, and in the Government Departments was not doing his "business as usual," but making it his special business to provide the nation with the scientific material and machinery by which alone can our forces achieve success in the present conflict.

MODERN ELECTRICAL THEORY.

The Electron Theory of Matter. By Prof. O. W. Richardson. Pp. vi+612. (Cambridge: At the University Press, 1914.) Price 18*s.* net.

THIS book is based on a series of lectures delivered by Prof. Richardson at the University of Princeton, and gives a general survey of the electron theory. The book starts with an account of the elementary principles of the theory of electricity and magnetism, and a discussion of phenomena which can be explained on the general Maxwell theory. From this we are gradually led to the discussion of such phenomena as dispersion and selective absorption, which have first found satisfactory explanations on the electron theory. Next follows a closer account of the theory of the mechanics of electrons, containing detailed considerations of the problems of electromagnetic mass, the radiation from an accelerated electron, and the properties of moving systems. This part ends with a brief account of the principles of the theory of relativity. After this we return again to the consideration of the general properties of matter, and the results deduced in the preceding chapters are

employed in a discussion of the bearing of the electron theory on the problems of temperature radiation, magnetism, and the theory of metallic conduction. Finally, after an account of the theories of spectroscopic phenomena and the phenomena of radio-activity and X-rays, we are led into a discussion of the theories of the constitution of the atom.

It will be seen that the book covers a very extensive field. To give an adequate representation of the entire electron theory is naturally a task of the greatest difficulty, but the author appears to have done this in an admirable manner. Of necessity the treatment is at many points very restricted, but almost all points of general interest are considered. If any problem is treated more fully than others it is the theory of metallic conduction, as might naturally be expected from the author's own work. The exposition is throughout very clear and concise, and Prof. Richardson possesses a great gift of making even complicated arguments very easy for the reader to follow. A close connection with the latest experimental progress is everywhere maintained, and problems which involve hitherto unsolved difficulties are treated in a manner very far from being dogmatic.

In reading Prof. Richardson's book one gets ample opportunity to think about the present state of theoretical physics. The collection of the numerous brilliant achievements of the electromagnetic theory and the electron theory fills one with the greatest admiration. Still, the difficulties, first discovered with relation to the problem of temperature radiation and later in other problems, seem to be so great and of such a fundamental character that the theory will need very great alterations. Even if a way is indicated by Planck's theory no satisfactory solution of the difficulties has yet been found. In text-books only a few years old one finds great enthusiasm over what was called the future programme of the electromagnetic theory. It was believed that this theory constituted a final accomplishment of ordinary mechanics, and there appeared to be no limit to the application of the general principles of the theory. This attitude has changed most decisively. The impression obtained by reading the present book, however, is anything but merely disillusioning. Scarcely at any time has our knowledge increased so very rapidly as of late years, and, above all, we now possess much more powerful methods of experimental attack than were dreamed of a short time ago. Especially investigation of the radiation from radio-active bodies has proved most efficient in disclosing the internal structure of the atoms. If at present we may speak of a programme for the future development, it would, perhaps, be to examine the constitution of the special atomic systems actually existing, and then, by means of the directly observable properties of matter, possibly to deduce the general principles. If so, the evolution would be exactly the reverse of that anticipated.

In the present unsettled state, Prof. Richardson's book, which gives a balanced and masterly survey of a wide range of knowledge, will no doubt be especially welcome. It can be most heartily recommended, not only to students who seek an introduction to the electron theory, but to all interested in the modern development of physics. N. B.

HORTICULTURE AND BOTANY.

(1) *The Standard Cyclopedia of Horticulture.* Vol. ii., C–E. By L. H. Bailey. Pp. 603–1200. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 25*s.* net.

(2) *Forage Plants and their Culture.* By C. V. Piper. Pp. xx+618. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 7*s.* 6*d.* net.

(3) *American Science Series. Essentials of College Botany.* By Prof. C. E. Bessey and Prof. E. A. Bessey. Pp. xiv+409. (New York: Henry Holt and Co., n.d.) Price 1.50 dollars.

(4) *The Story of Plant Life in the British Isles: Types of the Natural Orders.* Vol. ii. By A. R. Horwood. Pp. xiv+358. Vol. iii. Pp. xvi+514. (London: J. and A. Churchill, 1914.) Price 6*s.* 6*d.* net each.

(1) THE second volume of Bailey's "Cyclopedia of Horticulture" contains information on every subject pertaining to horticulture from "Cabbages" to "Extension Teaching in Horticulture," and is of a remarkably comprehensive character.

Every plant of interest the name of which lies between these two extremes is referred to; the derivation of the name is given, descriptive particulars of the plant, its geographical distribution, and notes on its method of cultivation go to make up each successive article. The book, though written primarily for the American horticulturist, contains much valuable information for extra-American countries. Certain articles, as that on the chestnut, remind one of the American origin of the work, as we are fortunate in being free from the dreaded chestnut fungus *Diaporthe parasitica*, which has caused such havoc in the United States. Diseases and insect pests receive extensive notice, and some forty double-column pages are taken up with descriptions of the various pests and the means of combating them. As with other

articles, the text figures of fungi and insects are numerous and on the whole well-executed.

The genus Crataegus, which reaches so conspicuous a development in the States, has been carefully worked up by Prof. Sargent, and some nine hundred species are now recognised, to the confusion of European botanists and gardeners. In the encyclopædia the account of the genus occupies nearly eleven pages from the pen of Mr. Rehder, and the key to the fifty species which he mentions lends considerable value to the article. Eucalyptus again, another enormous genus but this time of introduced plants, occupies twelve pages, and there is a large illustration of a very fine specimen of *E. viminalis* growing in California. The key, which refers to as many as seventy-six species, is followed by short, useful descriptions with a few text-figures interspersed. Other large genera which fall within the compass of this volume are Cereus, Dendrobium, Echinocactus, Echinocereus, and Euphorbia, all of which receive very careful treatment.

There are a certain number of full-page illustrations, either in colour or in the form of photographic reproductions, which are well executed; among the latter that of cranberry-picking in a New Jersey bog makes a delightful picture; the coloured plates might have been dispensed with as they are of no particular interest. It is difficult to find any plant of importance or value which has been omitted. Owing to the large amount of material included, the volume is unduly bulky, and like other American publications suffers from its weight.

(2) "Forage Plants and their Culture" comes from the master-hand of the agrostologist in charge of forage-plant investigations of the United States Department of Agriculture, and is a valuable and well-illustrated agricultural handbook.

The introduction deals with forage crops generally, and in connection with the legumes an account of root nodules and nitrification is given. The chapters which follow treat of the preservation of forage and choice of crops, in which the results of feeding experiments, chemical analyses, the chemical composition as affected by the state of maturity of the crop, and other particulars are given.

The chapter on "Seeds and Seeding" is illustrated by useful plates showing the noxious weed seeds found among farm seeds. "Meadows and Pastures" and statistics of forage crops occupy the two next chapters. These are followed by detailed accounts of various crops, such as timothy, blue grasses, meadow grasses, the bromes, the sorghums, millets, and other grasses which figure prominently among the valuable forage plants of the United States. Among the legumes, alfalfa or lucerne occupies the first place, and the various clovers, peas, and vetches, soy beans, and other sub-tropical leguminous plants are discussed in some detail.

Root crops also come in for their share of attention. The book is written for the agriculturists of the United States, but the information it contains should prove of value to agricultural workers in South Africa, Australia, parts of northern India, and British East Africa, where many of the forage plants mentioned in the book can be successfully grown.

(3) A text-book which is said to contain only the essentials of the subject and written for "college teachers" may well be an uninteresting production, and that by Profs. C. E. and E. A. Bessey cannot be considered inspiring. It is to be hoped that the teachers who will use the book have already had their interest in botany roused and their enthusiasm for the subject fired by other teachers before taking up "the essentials" as a course of study. Not even the illustrations lend a helping hand, as they are singularly poor, and those of nuclear division are almost childish.

Though largely a very elementary treatise, the chapter on the chemistry of plants, with its masses of formulæ, is a formidable affair, and is too condensed to be of much practical value. The latter part of the book consists of a rapid classificatory survey of the vegetable kingdom with poor little figures. The book should not meet with much popularity on this side of the Atlantic.

(4) Mr. Horwood's second volume follows similar lines to the first one previously reviewed in NATURE. The introduction gives a rapid review of general botanical information which is not always sound; the statement on p. 8, for instance, that if the nucleus is damaged the plant dies, would suggest to the uninitiated that a plant possesses only a single nucleus. Other sweeping assertions, such as "the endodermis . . . is graviperceptional," that parasitic plants possess root-hairs, and that "the protection of the stomata from being clogged is ensured by the provision of hairs and their occurrence on the under-side of the leaf," may be received with caution by those who have a wider knowledge of botanical facts.

Mr. Horwood, after mentioning that "very little free nitrogen is obtained from the air by plants," proceeds to remark on the temperatures favourable to plant growth, and apparently without having made his calculations from Centigrade to Fahrenheit, states that the "most suitable temperature for plant growth is about 28° C., though plants can grow below this," and further, "above a temperature of 56° C. plants usually die." This

latter statement corresponds fully with our own experience. For the rest, the book treats in detail of the Thalamifloræ, Calycifloræ, and certain Gamopetalæ; descriptions of the plants and their natural orders are given, and there are numerous illustrations reproduced from photographs.

The author states that "the facts of botany, like those of zoology . . . are capable of reduction to orderly arrangement," and it is to be regretted that he has not found himself able to follow out his opening text in the ordering of his material.

The third volume recently issued completes the work. There are 95 pages of introduction dealing with germination, plant formations, and many other unrelated subjects. These are followed by three chapters devoted to the Corollifloral and Apetalous Dicotyledons, and the Monocotyledons. There are numerous photographic illustrations.

MANUALS OF PHYSICS.

(1) *Practical Heat, Light, and Sound.* By T. Picton. Pp. xv+151. (London: G. Bell and Sons, Ltd., 1915.) Price 1*s.* 6*d.*

(2) *Notes on Practical Physics for Junior Students.* By Prof. C. G. Barkla and Dr. G. A. Carse. (London: Gurney and Jackson, 1915.) Price 3*s.* 6*d.* net.

(3) *A Text-book of General Physics for College Students.* By Dr. J. A. Culler. (Philadelphia and London: J. B. Lippincott Co., 1914.) Price 7*s.* 6*d.* net.

(4) *Manuale di Fisica.* Vol. ii., Acustica, Termologia, Ottica. By Prof. B. Dessau. (Milan: Società Editrice Libraria, 1915.) Price 15 liras.

(1) SMALL school text-books frequently receive but scant attention from reviewers, but, when it is remembered that it is exactly in the earliest stages of a subject that students should be led to acquire those correct habits of thought and outlook without which real advance is impossible, we are not altogether persuaded that this attitude can be justified. It was with this in mind that Mr. Picton's book for the middle forms of schools was examined. An experimental exercise should have for its objects, first, the elucidation of physical principles, and secondly, should show how to conduct the measurements so as to obtain the best numerical result with the means at the disposal of the class. Most teachers will agree that the second of these is more easily secured than the first. As the preface puts it:—"A pupil may carry out conscientiously the written instructions, obtain a 'good result,' write a neat account, and yet have very indistinct ideas (and often no ideas at all) of the principles underlying the experiment." To overcome this mental inertia several questions are associated with each exercise, which must be answered before the student is allowed to proceed to the next experiment. The instructions are brief but sufficient, and can be thoroughly recommended for class-work. It may especially be noted that in the optical experiments a method is used which makes visible the paths of the rays—a considerable gain at this stage. The sections on concave lenses need revision, as the methods given are not the best available; also it would be a great advantage in future work if some use were made of books of tables, especially of reciprocals in lens experiments.

(2) Prof. Barkla and Dr. Carse's book is apparently a collection of some of the instructions used in the authors' laboratory at Edinburgh University. For the students there it will doubtless supply all that is required in the elementary classes, but beyond this it is not clear that it will fill any gap in the existing literature. As the directions are not written with reference to special forms of apparatus, they are available for the senior forms of schools. The first chapter on "Treatment of Observations and Determination of Error" is the best elementary discussion of the subject that we have seen.

(3) A comparison of English and American text-books of physics for colleges reveals a series of interesting differences. Taking them in order:—(1) American authors usually reduce the mathematical portions to a minimum; a rather unexpected feature if it be true that instruction in the States is so much more systematic than here, for in that case the usual excuse—that the student's mathematical knowledge is behind his physical requirements—should not be allowable. (2) More emphasis is placed on technical applications; a great advantage if the corresponding theory is developed. (3) There is a determination to be up to date as regards modern theories.

It is this last feature that is most strikingly in evidence in Dr. Culler's text-book. The author has set out to produce "a logical development of the live topics which, it seems, should be included in a text-book for college students," and, on the logical side, has not been altogether successful. To give two illustrations:—He desires to explain all the elementary electrical phenomena in terms of electrons, and finds it necessary to start the first paragraph with "What electricity is," followed on p. 3 with "Evidence for the electron theory," including a description of Thomson's experiments on kathode rays. Similarly, in the first page on magnetism we find ourselves immersed again in electrons. In each case terms have to be used which, at that stage, are incapable of

definition, and a number of statements are made which the reader must take on faith. In several instances the treatment is too sketchy to be of any practical value; thus two pages are allotted to photometry, half a page to thick lenses (in spite of their technical importance), five pages to radio-activity, and twenty-three to sound. Nevertheless, if these blemishes are allowed for, it may be granted that the book is clearly and interestingly written, well got up, and likely to excite and retain the interest of the reader; but to take full advantage of its good qualities the student must not come to it as a beginner.

(4) Prof. Dessau's book, the second volume of a large text-book of physics, is admirable in its elegance, clearness, and choice of matter. The chapters on thick lenses and optical instruments may especially be mentioned as models of conciseness and lucidity. (Why is it that modern methods of determining refractive indices receive no mention in English books on physics other than those on physical chemistry?) But surely a book of 600 pp. should have an index!

EVOLUTIONARY MEDICINE.

(1) *Evolution and Disease*. By Dr. J. T. C. Nash. Pp. viii+73. (Bristol: John Wright and Sons, Ltd.; London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1915.) Price 3*s*. 6*d*. net.

(2) *The Vicious Circles of Neurasthenia and their Treatment*. By Dr. J. B. Hurry. Pp. xv+90. (London: J. and A. Churchill, 1915.) Price 3*s*. 6*d*. net.

(1) IN this work Dr. Nash first traces the history of certain epidemic diseases, in particular the Black Death, during the Middle Ages in Great Britain. An interesting chapter deals with the medieval psychopathic epidemics, such as the dancing mania. Much of this has necessarily appeared elsewhere, but it is none the less convenient to have the scattered literature of the subject thus briefly epitomised. The reader will probably turn with most interest to the chapters dealing with evolution and disease—in particular with the evolution and mutations of disease germs. As regards diphtheria, for example, the author states that diphtheroid organisms in throat swabs are uncommon except in cases of definite sore throat or in "contacts" with diphtheria or sore throat, that genuine cases of diphtheria with typical diphtheria bacilli often show later only diphtheroid bacilli in the throat swabs, and that some streptococci, some torulæ, the Klebs-Löffler bacillus, Hofmann's bacillus, and certain other diphtheroid bacilli, have a common ancestral origin, and concludes that the fact that bacteria and protozoa can be profoundly affected by environment is abundantly established, and evolution in relation to the germ cannot be gainsaid.

A topical interest is introduced in the final chapter on war as a factor in the evolution of epidemics.

(2) Dr. Hurry describes with considerable skill the vicious circles associated with that protean disorder known as neurasthenia. As an instance of a "vicious circle," that in connection with the heart may be quoted:—

"The sequence of events is somewhat as follows: The fear of organic heart disease leads to auto-suggested sensations in the cardiac region, followed by disturbance of the cardiac action, such as rapid heart, occasional extra beats with palpitation, and an intermittent pulse. The associated sensations then arouse distress and terror, which in their turn further disturb the cardiac action. Such attacks are especially common at night, and may be caused by nightmare, and the operation of this Circle may reduce the neurasthenic person to a condition of utter misery. Even fatal syncope may result."

It will thus be seen that the neurasthenic condition becomes evolved, as it were, given some factor which serves to start it and set in train the "vicious circle."

As regards treatment, while the principles are, it is true, indicated, the physician who desires real guidance will find little to help him, and we think that this part of the book might be usefully extended. R. T. H.

OUR BOOKSHELF.

Heating and Ventilating Buildings. By Prof. R. C. Carpenter. Pp. xiv+598. Sixth Edition. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 15*s*. net.

DURING the twenty years since this book was first published there have been many changes in methods of heating and ventilation. The present edition has been enlarged considerably by the addition of matter necessary to make it an up-to-date treatise on the subject. The author, who is well known as the professor of experimental engineering at the Cornell University, has dealt with the principles in a scientific manner, and has placed the various practical rules as far as possible on a rational foundation, at the same time avoiding the use of complicated mathematics. The earlier chapters are taken up with the properties of heat, the flow of water, steam and air, and the boilers and fittings required for steam and hot-water heaters. The remainder of the book contains thoroughly well illustrated descriptions of modern heating systems and includes gravity steam-heating, pump return steam-heating, hot-water and hot-air systems. There are also sections dealing with mechanical ventilators, heating with electricity,

temperature regulators and air conditioning. The sections dealing with the amount of heat required for warming and with the heat given off from radiating surfaces are of special interest. It must, of course, be understood that the efficient warming of a large building is a matter that is not susceptible of absolute mathematical calculation, and a great deal of the measure of success attained lies in the manner in which the warming and ventilating appliances are handled by those in charge. The volume before us has proved in the past to be a useful guide to architects and others responsible for providing the arrangements, and with the information which it now contains will no doubt prove equally useful in the future.

Structural Steel Drafting and Elementary Design. By C. D. Conklin, Jr. Pp. vii+154. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 10*s.* 6*d.* net.

THE author's object in compiling this book has been to provide a treatise dealing adequately with the preparation of shop detail drawings of structural steel work. Such a book is required no less in Great Britain than in the United States. In both countries there are several very good books dealing with the design of structural steel work. Some of these contain excellent expositions of the more theoretical work, but they do not meet the requirements of the practical draughtsman, and speaking generally, leave the reader with a very small knowledge of structural details. The book before us gives a clear and minute description of the methods adopted in some leading American drawing offices, and includes designs of riveted connections, beams and columns, steel roofs, a deck plate girder railway bridge, a through girder bridge, etc. Fully-dimensioned working drawings are given as well as the simpler calculations required in the design. The book is thus suitable for use in technical colleges, and provides a fairly complete course in structural drawing office practice. With a few minor modifications, which the teacher can easily supply, the book can be brought into line with British practice and nomenclature, and ought to be of service to students of structural steel work in this country.

Calculus Made Easy. By F. R. S. Second Edition. Pp. x+265. (London: Macmillan and Co., Ltd., 1914.) Price 2*s.* net.

THE author of this book has added many worked examples and exercises to those in his first edition; otherwise the book is but little altered and we have not much to add to the remarks we made five years ago. The motto is, "What one fool can do, another can." Perhaps there may still be too many encouraging remarks of a jokesome nature and too many expressions of disdain for the stupidity of the usual methods of teaching, but the title of the book is justified. The author does show that the most fundamental operations of the calculus are easy to understand and may be performed by beginners with success, that is, without vague notions of being wrong. J. P.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Surface Tension and Ferment Action.

MESSRS. BEARD AND CRAMER, in a paper under the above title published in the Proceedings of the Royal Society issued on June 1, describe experiments made with invertase with the object of determining "whether the action of a ferment on a substrate is affected by surface tension." They answer this question in the affirmative and draw far-reaching conclusions.

The method they use, however, is open to very serious criticism; we think that there is little doubt that the phenomena they describe are due entirely to the effect of alkali and not to change of surface tension. They have compared the activity of invertase towards cane-sugar in tubes filled either with glass wool or with capillary glass tubes or with glass beads with that of a control in an ordinary test-tube. Retardation of action was observed in all such cases.

All who have experience in working with saccharoclastic enzymes are well aware how extraordinarily sensitive these are to the influence of the minutest trace of alkali. This applies to the enzyme invertase in particular. In a paper published in the Proceedings of the Royal Society so far back as 1907 (Series "B," p. 362) we pointed out that unless hard glass vessels were used, it was impossible to obtain consistent results; in fact, it is not only necessary to carry out the action in hard glass vessels but it is essential also to use storage bottles and measuring pipettes of similar hard glass: even then the results are apt to be irregular.

The work done by Sörensen in co-ordinating enzyme activity with the degree of alkalinity or acidity of the medium is too well known to need description; his experience with invertase shows clearly how much the activity of the enzyme is influenced by the minutest trace of alkali. We look in vain in Messrs. Beard and Cramer's paper for any reference to the possible influence of alkali derived from the soft glass they used as a cause of retardation; it would appear that they have entirely overlooked this factor. So long as no definite evidence is brought forward to show that the retardation change they observed is not due to the action of alkali, it is unnecessary to attribute it to the influence of surface tension.

E. F. ARMSTRONG.
H. E. ARMSTRONG.

Training for Scientific Research.

IN connection with our position in regard to chemical industry, the present seems to be a suitable time for a careful discussion of what is doubtless not a new suggestion. It is a sufficiently obvious fact that the German chemical trades—especially those that most require highly-trained chemists—prosper in very much greater measure than our own, and, by general consent, the reason for this appears to be that the Germans appreciate the value of research more than we do. How then is a better appreciation of research to be fostered in this country? Various proposals to this end are being made; closer relationship between technical and theoretical chemistry, whatever that may mean; the establishment of an industrial council; the founding of scholarships, etc., all, doubtless, good things in their way, things, however, which have been

tried already to some extent, but unfortunately without sufficient success to justify an expectation of their being able completely to accomplish the desired change.

In considering this question we ought, it appears to me, to search for some distinct difference between our educational practice and that of Germany, some difference great enough to be likely to have an important effect. Such is indeed easy to find, for there exists a difference so great that it might quite readily lead to very important results, and one which, probably because of its obviousness, is generally ignored. This far-reaching difference is simply that in Germany research work is absolutely indispensable for the *ordinary* degree (by "ordinary" I mean that ordinarily taken by students), and it is at least a very reasonable contention that the moment research work becomes essential for our ordinary degree (B.Sc.), with, naturally, any necessary lengthening of the course, so soon shall we have taken the step which will, not to-morrow, but in ten or fifteen or twenty years' time, perhaps place us on something like an equality with Germany in respect to the point at issue.

Two most important results might be expected to follow the introduction of compulsory research into the B.Sc. degree: (1) There would be provided throughout the country a considerable body of young chemists with some experience, say one year, at least, of research work. There is such a thing as a general method in research, and after even only one year's training in it the young chemist would be able to attack, with very much greater confidence than at present, many of the problems which arise in industrial practice, for in research work, emphatically, it is the first step that counts for most, and this first step being a thing that can be taught, it is the duty of the universities to teach it. (2) Sons of manufacturers who go to the university and take a science degree would of necessity carry out some original investigation, and from this particular class—composed of men who, for the most part, are possessed of some means and leisure—there would be likely to emerge a number of really capable chemists, who might indulge in the higher degree of D.Sc., men likely to carry their chemistry intelligently into their businesses. But even in those least interested there would necessarily be acquired some idea of what research means, some notion of how it might be applied to their own particular requirements, and it is probable that in a comparatively short time, say twenty years, the lack of appreciation of research work which is now attributed to the manufacturer would have wholly or largely disappeared.

In fact, the introduction of research into the ordinary degree would be likely to act in several ways. First upon the student, secondly upon the manufacturer, and thirdly upon theoretical chemistry by the achievement of the excellent educational principle, that the science would be the richer in some fact or in some theory for every graduate who had devoted himself to it. Fourthly, it would react upon the teachers.

Although this is, essentially, an exceedingly simple reform, there would doubtless be great difficulties in carrying it out; it would probably be urged that M.Sc. degrees have been instituted with this especial object, but that would be to misunderstand the present suggestion, the essence of which is that there shall be no degree at all, or anything resembling a degree, which does not require research work. At the present time, however, when traditional prejudices of all sorts are going by the board, it would probably be easy for the teachers to bring sufficient pressure to bear upon Parliament, or conversely, for Parliament or a resolute Government to bring sufficient pressure to bear on the teachers, to secure the immediate accomplishment of this desirable improvement.

It must, however, be sorrowfully admitted that such a change is not likely to make any particular financial difference to the young chemist, but in all probability it would give him a better opportunity for advancement once he had established himself in a technical post, and there is little doubt that the advantage to the country would be very great.

T. S. PATTERSON.
University of Glasgow (Organic Chemistry Department), June 8.

Galileo and the Principle of Similitude.

WHEN I said in NATURE (April 22) that Herbert Spencer was the first to apply the principle of similitude to dynamical problems in biology, I spoke in haste. I might have remembered that Borelli had shown, by help of this principle, that a man would never be able to fly by his own muscular power, and why (for instance) small animals are more active and leap higher than big ones. But I was quite ignorant of the fact that Galileo had treated the whole subject on the broadest lines and with the utmost clearness. His discussion will be found in the "Dialogues concerning Two New Sciences," admirably translated by Prof. Henry Crew and Alfonso de Salvio (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914). So numerous and interesting are the subjects dealt with in this wonderful book that the writer of a long and laudatory notice in NATURE (December 24, 1914) had not time or space to mention that the principle of similitude and the subject of animal mechanics are alluded to therein. The following extract (*op. cit.*, p. 130) is but a small part of what Galileo has to say upon the principle of similitude:—

"*Salviati*: 'From what has already been demonstrated, you can plainly see the impossibility of increasing the size of structures to vast dimensions either in art or in nature; likewise, the impossibility of building ships, palaces, or temples of enormous size in such a way that their oars, yards, beams, iron-bolts, and, in short, all their other parts will hold together; nor can nature produce trees of extraordinary size, because the branches would break down under their own weight; so also it would be impossible to build up the bony structures of men, horses, or other animals so as to hold together and perform their normal functions if these animals were to be increased enormously in height, for this increase in height can be accomplished only by employing a material which is harder and stronger than usual, or by enlarging the size of the bones, thus changing their shape until the form and appearance of the animals suggest a monstrosity. To illustrate briefly, I have sketched a bone the natural length of which has been increased three times and the thickness of which has been multiplied until, for a correspondingly large animal, it would perform the same function which the small bone performs for its small animal. From the figures here shown you can see how out of proportion the enlarged bone appears. Clearly, then, if one wishes to maintain in a great giant the same proportion of limb as that found in an ordinary man, he must either find a harder and stronger material for making the bones, or he must admit a diminution of strength in comparison with men of medium stature; for if his height be increased inordinately, he will fall and be crushed under his own weight. Whereas, if the size of a body be diminished, the strength of that body is not diminished in the same proportion; indeed, the smaller the body the greater its relative strength.

Thus a small dog could probably carry on his back two or three dogs of his own size; but I believe that a horse could not carry even one of his own size.'

"*Simplicio*: 'This may be so; but I am led to doubt it on account of the enormous size reached by certain fish, such as the whale, which, I understand, is ten times as large as an elephant; yet they all support themselves.'

"*Salv.*: 'Your question, Simplicio, suggests another principle. . . .'"—And thereupon the two disputants go on to discuss the effect of immersion in water, of how by reason of its density (*corpulenza*), or, "as others would say," its heaviness (*gravità*), the weight of bodies immersed in it is diminished; and how accordingly the body of the fish is rendered, so to speak, altogether devoid of weight, and is supported without any injury: though if a giant fish, or a great and heavy-laden ship, were drawn ashore, it would be apt to go all to pieces, crushed under its own mass.

Galileo points out that Aristotle had an inkling of the principle in that chapter of his "Mechanics" where he discusses the question, "Why a long beam is weaker than a short one"—even though the long beam be thick and the short one be thin. But at the beginning of his treatise Galileo makes it clear that he regards the general statement as a discovery of his own, and as one of great importance which moved him even to astonishment.

D'ARCY W. THOMPSON.

The Names of Physical Units.

A L'OCCASION de l'aimable analyse consacrée au "Recueil des Constantes physiques" (NATURE, May 13, p. 281), M. J.-A. Harker s'étonne de certaines expressions insérées dans le tableau dont je suis à moitié responsable, et qui sert de préface à tout l'ouvrage. Je dis "à moitié," car, à l'encontre de ceux qui se rapportent à des constantes proprement dites, le tableau des unités a été discuté et approuvé dans sa terminologie par la Commission tout entière; j'ai seulement proposé, la Commission a disposé.

Le terme *stéradian* n'a pas l'approbation de M. Harker. Evidemment, il n'est pas encore consacré par un usage international, et c'est là, peut-être, son plus gros défaut. Les physiciens français toutefois l'emploient couramment pour désigner *l'angle solide découpant, sur la sphère, une superficie égale au carré du rayon, ou l'angle solide égal au quotient de l'espace entier par* 4π. On conviendra que l'une ou l'autre de ces expressions est encombrante, et qu'une contraction était au moins désirable.

Stéradian est logique, puisqu'il résulte de l'association de radian (angle plan unité) et du préfixe impliquant la solidité ou l'espace à trois dimensions. J'ose donc espérer, malgré l'étonnement de M. Harker, voir nos confrères britanniques adopter ce terme. Ce serait une aimable réciprocité à l'hospitalité donnée par les sportsmen continentaux au mot *starter*, grâce auquel ils évitent aujourd'hui la périphrase: *Fonctionnaire chargé de donner, dans une course, le signal du départ;* tout comme le titre qu'ils s'octroient abrège cette autre appellation: *Gentlemen consacrant une partie de leurs loisirs aux exercices musculaires.*

La question du degré carré sera résolue avec celle du stéradian. C'est bien, si je ne me trompe, au moyen de cette unité que les astronomes évaluent, entre autres, l'espace de la sphère céleste que couvre un cliché photographique.

Une autre espèce d'expressions a frappé M. Harker: *masse volumique, volume massique.* Dans le tableau en question, ces expressions sont inscrites entre parenthèses, en subordination, pour ainsi dire, des termes classiques mais bien peu satisfaisants: *Densité absolue* et *volume spécifique.* Si j'avais eu une entière liberté, j'aurais certainement franchi l'étape et renversé l'ordre. Quel qualificatif, en effet, laisse plus de vague à l'esprit que celui de spécifique? On dit masse spécifique: quotient de la masse par un volume; volume spécifique: quotient d'un volume par une masse; spécifique a, ici, les deux acceptions exactement opposées, sans compter, dans d'autres cas, une foule de sens divergents. En fait, spécifique signifie tout ce que l'on veut, et par conséquent ne signifie rien du tout. La vieille terminologie laisse encore traîner dans la physique des expressions telles que *chaleur spécifique* (capacité calorifique rapportée à la masse) et *résistance spécifique* (résistance rapportée aux dimensions) et tant d'autres, pour l'intelligence desquelles le physicien est chaque fois obligé de faire appel à sa mémoire, sans aucune certitude d'être d'accord avec un confrère dans le sens à attribuer à une même expression.

Il fallait rompre un jour avec ces errements; la plupart des physiciens français, sur la proposition d'Hospitalier, ont accepté depuis des années les expressions que j'ai insérées dans le tableau, comme les mécaniciens français ont adopté, dans la technologie, des termes tels que *puissance massique,* auxquels le lecteur non prévenu ne peut se tromper, tant ils font image.

Ne pouvons-nous, au contraire, regretter de voir nos confrères britanniques conserver des expressions telles que *specific gravity,* où specific est vague et où gravity n'a rien à voir? Je soumets le cas aux méditations de M. J.-A. Harker, avec la certitude qu'il m'approuvera, car il est métrologiste, c'est à dire homme de pensée claire et concise.

CH. ED. GUILLAUME.

Pavillon de Breteuil, Sèvres (Seine et Oise), le 17 Mai.

IT would appear from the interesting letter of the Director of the International Bureau of Weights and Measures that he has a little misunderstood my reference to the new expressions he employs in the preface to the "Recueil de Constantes Physiques." If he will refer again to the review to which he takes exception, he will see that, on the matter of nomenclature, all I wrote was:—

"Some eccentricities appear in the initial table on units; few physicists are familiar with such terms as 'volume massique' and 'masse volumique,' 'degré carré' and 'stéradian.'"

I expressed no opinion as to the suitability of any of the terms in question, but only pointed out that in my view they were as yet far from familiar to the average physicist.

I have taken an opportunity of testing the accuracy of this opinion by consulting six of my colleagues. Not one of these had a clear and definite idea of the meaning of all four of the terms in question.

The introduction of a new name for a unit or an alteration in nomenclature should be a matter for the most careful consideration, particularly if it is intended for general international use; more harm than good may easily be done by an injudicious choice, even if supported by a great authority.

"Stéradian," and the other terms too, may be logical, but it is unpractical to attempt to build a language simply upon logic.

Dr. Guillaume will remember that some time after the use of the term *micron,* with its corresponding symbol, the overworked letter μ, had been introduced into metrology, as the name for the millionth part of a metre—I believe I am correct in saying, largely through the influence of Dr. Benoit—Lord Kelvin,

probably unaware of this, proposed that the name *michron* be given to the millionth of a second, while he suggested that the micrometre be termed the *microm*.

Similarly, many years ago Sir Benjamin Brodie attempted to induce the chemists to rationalise their nomenclature by re-naming CO carbon*ous* oxide, and taking the name carbonic oxide for CO_2.

Had either of these proposals even partially materialised, it would undoubtedly have led to great confusion.

While to some extent I agree with Dr. Guillaume's remarks regarding the English use of "specific," I do not think he strengthens his general case by referring to "puissance massique," which, to my mind, conveys only the haziest sort of meaning.

I might point out that, according to a view I have heard frequently expressed, the general introduction of the metric system into England has been hindered by prejudice against what is considered the unnecessary number of names of units appearing in the usual books dealing with the subject. It may be desirable to have these for rare use, but it is surely inadvisable to mention them in the school books as if they were current. Thus, for example, among measures of length, one is accustomed to think in metres, centimetres, or millimetres, and of greater lengths in kilometres. The decimetre is rarely used except in connection with the litre, and the decametre, hectometre, and myriametre practically never.

In conclusion, I think I represent the views of readers of NATURE when I say that many of them will be glad to buy the French Physical Society's useful volume, if it is only to be able to get rid from their library table of one or other of the editions of its well-known predecessor, written in the language of the Huns, which at the present moment they are unable to tolerate. J. A. HARKER.

Teddington, May 25.

University Appointments in War Time.

I VENTURE to direct attention to the advertisement for a professor of organic chemistry in the University of Liverpool. It appears to me, and I believe many share my opinion, that this is a very inopportune moment for filling a university chair when eligible men are away on active service. It may seem unfitting to criticise the internal policy of another university, but it is a matter which closely affects many who have no connection with the University of Liverpool. Professors of chemistry and others are being solicited for testimonials by candidates, and in many cases such requests cannot be granted except by doing a grave and irreparable injustice to more highly qualified men who have responded to the country's call for volunteers in the present national crisis. I trust that the University of Liverpool will in this matter follow the same course as has been pursued by the University of Birmingham in the case of the vacant chair of physics, and postpone the appointment of a professor until after the termination of the war.

PERCY F. FRANKLAND,
(Dean of the Faculty of Science).

The University, Birmingham, June 12.

Volunteers for Scientific Work.

CIVILIANS of all grades are being enrolled as volunteer workers in our ammunition factories. Are there no Government chemical factories where persons of a certain amount of scientific training could render voluntary aid towards the production of chemical munitions of war? There must be many who, like myself, are beyond the fighting age, whose skilled labour might be of use at the present juncture.

EDWARD HERON-ALLEN.

Large Acres, Selsey Bill, Sussex, June 12.

SCIENTIFIC METHODS IN INDUSTRY.[1]

THE publication of this volume is opportune, for it presents data which will tend to focus attention still further upon the present unsatisfactory recognition of science by the Government and manufacturing interests of this country.

A state of war has disclosed this in detail; and demonstrated that a nation which is ill-prepared against industrial expansion in the modern sense, finds itself in an inferior position in times of war. For reasons which are still somewhat obscure, the British manufacturer has shown in the past a distinct preference towards those industries which develop best on lines of empiricism. Many have held that this is a defect; the present position has proved this to the hilt. Our manufacturers have surrounded themselves with an atmosphere which demands their whole attention in directing their ventures as they exist, manufacturing articles which depend upon a market already existing and the low selling price which always goes with such conditions. If empiricism were the only law of manufacture (as it was some fifty years ago) they would by their application outdistance all competitors.

It has been to Germany's credit that she realised the great driving force behind this system as it has been practised in the northern part of these islands, and that to turn the shield concentration in other directions was demanded, where some new factor could be introduced and the methods of empiricism were useless. British methods were not so much improved upon as superseded; scientific supervision and investigation were the beginning and end of this development; industries were built up which could not even have been started under the old *régime*; industrially useful products were in the scientific sense in many cases created, and then introduced into commerce. The older method of improving existing manufacture by empirical methods gave place to a new system. Thus the British manufacturer found himself face to face with the German industrialist, who had already convinced the German banks that he was working for a new era, where profits would be large and developments world-wide. To-day we have to consider a position where many of these new industries (by chance, or design) have been of the first importance in the time of war. The manufacture of large quantities of ammonium nitrate and nitric acid from synthetic ammonia (or the nitrogen of the air), has made Germany free from outside supplies of nitrates, and thus to some extent counteracted

[1] "First Principles of Production. A Study of the First Principles of Production and the Relation of Science to Industry." By J. Taylor Peddie. Pp. 231. (London: Longmans, Green, and Co., 1915.) Price 5s. net.

our command of the sea. Extensive coke-oven plants, while tending to commercial efficiency in times of peace, have given her a supply of raw material for high explosives in times of war. Her extensive liquid chlorine plant has also been turned to notorious use.

The lesson of all this is that a nation lags behind in scientific development at a cost of a possible loss of supremacy in times of war. A state of unreadiness in this direction is co-extensive with its influence and life. Industry developed on empirical lines has a certain advantage in times of peace, for it has at its command markets of great strength and deals with large outputs, but it is one-sided. It actually leads into a backwater where adventure is suppressed in favour of mere attention to detail; the walls of the factory or works being the natural bounds of the manufacturer's interests; his energies confined within a few yards of buildings. In other words he is working in the proverbial rut. Industrially he is entirely domesticated.

It would be impossible to deny that in certain directions this system has its advantages; or that many industries are undoubtedly sound under such conditions. Also that certain phases of Empire have partly directed industry into the lines we have followed, where a large output of universal application is essential. The distressing limitations of such a system have only come to be universally recognised under the stress of war.

Now the British manufacturer is called upon suddenly to turn industrialist, and to co-operate with the scientific investigator to consider our industry as a whole. The danger of such a rapid change will be seen in the persistence of command which is essential to empiricism, as seen in the attempt to control rather than co-operate. This will only represent a transition stage, serving a purpose in the course of a radical alteration in procedure.

It is for the scientific worker to see that this intermediate stage is made as short as possible; that recognition of the work of the investigator shall be complete in all directions. This can best be achieved by taking an active interest in industrial affairs. To be merely academic will not suffice, for this offers no encouragement to the manufacturer to hold out the hand of friendship. When obliged by the circumstance of the moment to seek scientific advice he has turned to those who have technical experience rather than a studied condition of brain energy directed in the display of pure science. That a severely academic attitude has reacted against the application of science to industry is certain. The effective antidote against such a condition is a greater interest in application, as apart from theory. This can be most easily achieved by a linking up with some specific industry, which method has led many a German chemist to widen his horizon and plan of research. The effect of such a change in this country would be magical. It would react progressively both on science and industry.

The scientific worker must never forget that the business man has achieved great things for this country in the past. This is our hope for the future when he will work in partnership with the experimentalist. Such a change in attitude is an essential preliminary to a working arrangement between the interests involved. The business man will then realise that a new factor has come into his affairs. While scientific endeavour is almost entirely confined within the college walls, and recorded in the journals of learned societies, this will remain unrecognised. What is required is an active partnership between the trained investigator and those who specialise in the means of actual manufacture. The manufacturer must be convinced that certain modern industries are so bound up with experimental science that they are inseparable; that they cannot be run on the lines which were so successful in the case of the older industries.

It may even be that a thorough awakening of science is more necessary than that the business man should afford recognition. So far as chemistry is concerned, the division of those actively engaged in this science (as roughly represented by the different societies) has not altogether made for progress as a whole. Science must speak with a collective authority and with no uncertain voice. It must demonstrate by the conduct of its own affairs that it is capable of leading; that its advent into the industrial (and political) world will bring order and not chaos. At this late stage of development, the English business man will only respond to a party which exhibits by action the essential qualifications of its watchword.

Thus the passing of a certain sense of exclusiveness on the part of those who follow research is a preliminary step towards recognition by the commercial world. An advance on parallel lines is not business. Against this system we have the close association of the German method which has resulted in a solid network of endeavour.

Just so long as our advance is confined to empiricism, so long will the work of the chemist be chiefly directed towards the mere testing of material, instead of the legitimate work of developing new processes and manufacturing new materials. The war has cleared the air, and clearly points to a new path which we shall do well to follow, the common one of partnership between science and industry.

The treatment in this volume of such matters as the influence of tariffs and political economy on the industries of a country will enable the general reader to grasp certain essential factors as they are recognised to-day by the contending schools. Chapters on finance and industry, and science and industry, are equally valuable as an introduction to these complicated and involved relationships, which are so little understood in certain quarters where they should really be mastered in detail. Not the least satisfactory feature of this volume is the reprinting, with notes

by Prof. R. A. Gregory, of Sir Norman Lockyer's address on the Influence of Brain Power on History, and articles on the Steel Industry by Dr. W. Lorrimer, and on the Chemical Industries by Prof. Percy Frankland.

W. P. DREAPER.

HAMPSHIRE FIELD ARCHÆOLOGY.[1]

SOME years ago Dr. Williams-Freeman undertook to make a list of "Defensive Earthworks of Hampshire" for the Hants Field Club, and when this was done, evidently with inexhaustible patience and enthusiasm, some discerning persons urged him to publish his plans and descriptions.

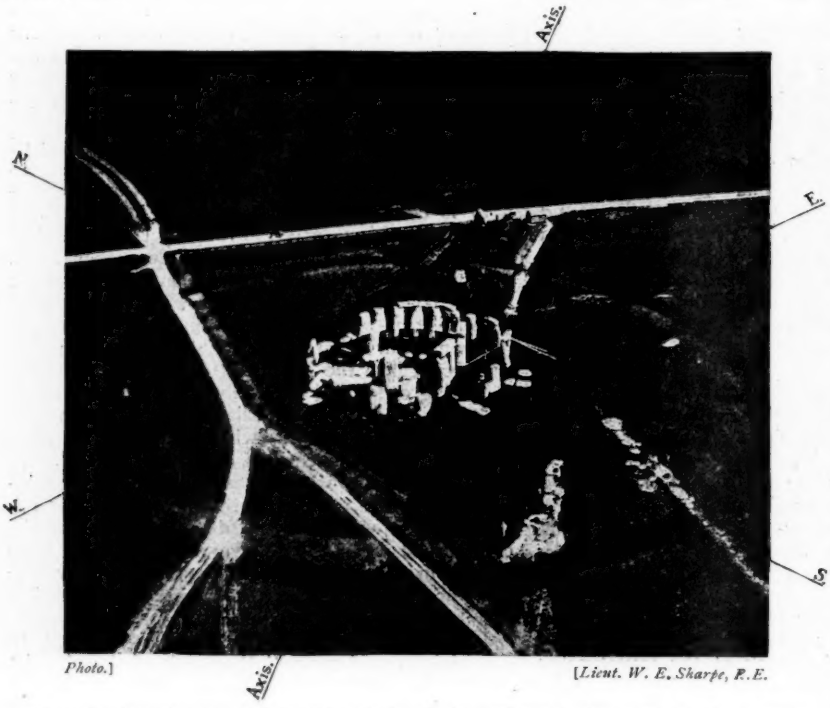

Photo.] [*Lieut. W. E. Sharpe, R.E.*

FIG. 1.—Stonehenge from a war balloon. From "An Introduction to Field Archæology as Illustrated by Hampshire."

The resulting book is divided into three sections, a division which adds considerably to its value and has made it far more generally useful, interesting and readable.

The first section deals with the general subject of field archæology, including earthworks, ethnology, roads, the influence of the natural features of the country on the nature of the earthworks likely to be found therein, etc. The author rightly insists on Field Archæology being the *Scientia Scientarum*, that all sciences are its handmaidens, and he enumerates several. But surely in the data and results accumulated, more especially since the beginning of this century, there is *prima facie* evidence for the inclusion of astronomy as a *sine qua non* in the equipment of the Field Archæologist.

The second part of the volume deals with particular earthworks visited in the form of a day's itinerary in each chapter. Distance, direction, state of roads, possible methods of locomotion, charming descriptions of the country and places of rest and entertainment are all given, yet never obscure the primary function of the book, the description of the earthworks. The author examines quite judicially many interesting, arguable points but never becomes dogmatic; there are also many practical hints which the amateur archæologist will find invaluable. For example, the finding of a Roman coin does not *prove* that the Romans *built* the earthwork, each of which may have been successively occupied by different peoples over a long period. The close investigation of all finds is absolutely necessary from all points of view, if faulty conclusions are to be avoided. *A propos* of this Dr. Williams-Freeman relates a story concerning "Black Bar" or "Black Barrow," an oval sandhill near Linwood. Certain excavators found charcoal and Roman pottery, but as regards the latter an "old inhabitant of the district says that in his youth he used to put bits of pottery into the hill in order to get the employment of digging them out"!

The fifth day's journey, according to schedule, takes us from Hampshire, because, being near to Stonehenge, it would be an "unpardonable archæological sin" not to visit our most famous and grandest megalithic monument. The author carefully describes the monument and, as is his custom, judicially sifts the archæological evidence concerning its origin and date. He points out that the date astronomically determined by Sir Norman Lockyer and Mr. Penrose has been independently confirmed by two other, totally different, lines of evidence and must be accepted. But the Friar's Heel was not the index mark for

[1] "An Introduction to Field Archæology as Illustrated by Hampshire." By Dr. J. P. William-Freeman. Pp. xxii+462. (London: Macmillan and Co., Ltd., 1915.) Price 15s. net.

the solstitial sunrise, as he seems to believe, and will not be for centuries.

An excellent view of Stonehenge, taken from a war balloon, is here reproduced (Fig. 1).

Another interesting illustration (Fig. 2) shows an inscribed stone, believed to be the only one of its type found in Britain, which lies near the Fosbury camp, some seven miles north-by-west from Andover. This stone is covered on its flat surface with curious, irregular, waved markings, for which, so far, no satisfactory explanation is forthcoming. The author compares it with a photograph of one of the sculptured stones found at Carnac, in Brittany, and remarks on the general resemblance. While generically similar there is a marked difference, for on most of the stones we have examined at Carnac and Gavrinis there is a regularity of pattern—a concentric system of semicircles standing on a diameter—which is lacking in the Hampshire "Kenward-stone." Yet the general similarity is very striking and the problem presented, as to the purpose and meaning of the patterns, is one of great interest. There can be no question as to the artificial origin of the markings on the stones seen in Brittany, especially those in the huge dolmen on the island of Gavrinis.

FIG. 2.—The stone by Chute Causeway. From "An Introduction to Field Archæology as Illustrated by Hampshire."

Such problems as these are raised and clearly discussed throughout the book. One surprising example is the description of the much-discussed "dew ponds," or, as the author prefers to call them, "mist ponds." He states that the Wiltshire pond makers "in their invincible ignorance" always put the layer of straw—the theoretical function of which is to act as an insulating layer—*on top of the clay*, "and yet their ponds somehow hold water better than their critics' theories." Evidently the subject of "dew ponds" is not yet exhausted!

We would fain discuss this Hampshire Archæology at greater length but space forbids, and we venture to believe that, when circumstances permit, many people will wish to take the book and follow the author's most interesting itinerary, seeing and discussing.

The third part of the work is invaluable and consists of eight appendices. The first gives the author's excellent method of measuring and taking notes; numbers two and three classify and locate more than 140 earthworks, etc., examined by the author in Hampshire. In the fourth and fifth each earthwork is briefly and scientifically described in a special note, and each description is accompanied by a hachured plan (scale = 1/5,000) and a section all properly scaled and oriented: this is most valuable. Then there are very brief descriptions of "supposed earthworks," a list of "places not yet visited," and some notes on the ancient roads in the country, while at the end there is a map of the country on which are superposed the positions of the various earthworks, etc., visited by the author.

W. E. ROLSTON.

COTTON FOR GERMAN AMMUNITION.

THE appointment of Mr. Lloyd George as Minister of Munitions is a sign that the reconstituted Government has at length realised the serious importance of ammunition in warfare. The complement of Mr. George's work will now surely be the exclusion of materials of ammunition from our enemies. It is now many months since Mr. Runciman, President of the Board of Trade, whose special mission was to deal with commerce with the enemy, was implored to place cotton and cotton goods on the list of contraband; it was urged that only by this course could the German troops be deprived of ammunition. But the attitude of mind which induced Mr. Runciman, some years ago, in criticising Lord Roberts' efforts to bring the nation to apprehend the danger which menaced us, to wish to "apologise to our good friends the Germans," appeared to have persisted. After much pressure, the Order in Council of March 14 was issued, apparently excluding cotton. The effect was nil. Cotton still poured into Germany, as appeared from returns chronicled in the *Times* of June 10, in answer to a Parliamentary question, where enormous increases in the exports of cotton and yarns into Sweden, Norway, Denmark, and the Netherlands in the figures for April, 1915, over those for April, 1914, were reported. Imports might have been stopped at once had cotton been declared contraband of war.

It is to be regarded as most unfortunate that Sir Edward Grey, in his letter to Dr. Page on January 14, gave the promise: "His Majesty's Government have never put cotton on the list of contraband; they have throughout the war kept it on the free list; and on every occasion, when questioned on the point, they have stated their intention of adhering to the practice." It is not going too far to say that this decision has, and will, cost Britain and her Allies many thousands of lives.

The supreme tragedy of this war is that while the patriotic and unselfish citizens of the Empire are risking all to save the world from German domination, our Government has been contributing to their destruction. To fight the enemy abroad is necessary, and calls for the utmost exertion of the manliest of our race; but to have to fight an enemy at home leads us to despair of victory. Even yet, cotton is entering Germany; and I learn from French sources that African wood ("ogoubi") and Norwegian wood pulp are being tried by the Germans as substitutes. These must all be declared contraband; that step, and that step alone, will deal a final blow to the enemy.

WILLIAM RAMSAY.

MR. F. H. NEVILLE, F.R.S.

BY the death, in his sixty-eighth year, of Mr. F. H. Neville, at Letchworth, on June 5, the scientific world, and metallurgists in particular, have to mourn the loss of a singularly gifted man and a most charming personality. Neville took his degree in the Mathematical Tripos of 1871, when he was bracketed fifteenth wrangler. He was elected a Fellow of Sidney Sussex College, Cambridge, in the same year. The bent of his mind was, however, in the direction of experimental science rather than mathematics, and early in 1880 he took over the management of the chemical laboratory at his college.

About 1888, the work of Raoult on the lowering of the freezing points of solutions was brought prominently into notice, and it occurred to Neville and Mr. C. T. Heycock to see if the same laws applied to metallic solutions. A first paper was read before the Chemical Society on June 3, 1889, on the lowering of the freezing point of tin by the addition of other metals, in which it was shown that, as regards a metal like tin, the effect of dissolving other metals was generally the same, so far as the freezing point was concerned, as in the case of aqueous and other solutions. After the first paper was published, more extended experiments were made, great trouble being caused by the rapid shift of zero of the mercury thermometers. With the assistance of Prof. Callendar and Principal E. H. Griffiths, Neville and Heycock were able to use the platinum resistance pyrometer, and from that time the thermal work was comparatively rapid and accurate. The investigations on alloys were continued with but slight intervals up to the autumn of last year, but by far the heaviest piece of work, both thermal and microscopical, was on the alloys of tin and copper; this formed the subject of the Bakerian Lecture.

In 1897 Neville was elected a Fellow of the Royal Society. No one knows better than the present writer how large a part Neville took in all the researches with which he was jointly associated, or how he could bring a mind trained in mathematical precision to bear on his scientific work. Only those who have dealt with the complex problems of alloys can appreciate the difficulty of disentangling the maze of experimental results and sifting out the good from the worthless, and so preventing the main problem from getting side-tracked.

Those who had the privilege of knowing Neville well were aware that he was a man of many gifts and wide reading—an excellent French, German, and Italian scholar, an authority on Italian history, and deeply interested in metaphysical speculations.

A more modest man, or one who had less push, in the worldly sense, it would be impossible to find. His death has left a deep gap, which his friends know well they will never be able to fill.

NOTES.

IN reply to a question asked in the House of Commons on June 14, it was announced that the Board of Trade had decided to dispense with the wool test for colour-blindness from January 1 next.

MR. J. B. TYRRELL, of Toronto, was elected president of the Geological Section of the Royal Society of Canada at its annual meeting held in Ottawa on May 25–27.

THE Institution of Mining Engineers has awarded its medal this year to Dr. J. S. Haldane, F.R.S., in recognition of his work on the causes of death in colliery explosions and other subjects connected with mines.

WE notice with much regret the announcement that Captain J. W. Jenkinson, late fellow of Exeter College, Oxford, and University lecturer in embryology, was killed on June 4 in the trenches in Gallipoli. He was forty-three years of age.

IT is announced in the issue of *Science* for May 28 that at its annual meeting, held on May 12, the American Academy of Arts and Sciences, acting upon the recommendation of the Rumford Committee, voted: "That the Rumford Premium be awarded by the Academy to Charles Greeley Abbott for his researches on solar radiation."

A JOINT meeting of the Aristotelian Society, the British Psychological Society, and the Mind Association will be held on July 3 and 5 next. On July 3 the meeting will take place at University College, Gower Street, London, W.C., when, at 6 p.m., the annual meeting of the Mind Association will be held. Prof. G. F. Stout will contribute a paper on Mr. Bertrand Russell's theory of judgment. On July 5 the meeting will be at 22 Albemarle Street, London, W. At 4 p.m. the annual meeting of the Aristotelian Society has been arranged, and at 5 p.m. there will be a symposium on the import of propositions, by Miss Constance Jones, Dr. Bernard Bosanquet, and Dr. F. C. S. Schiller.

WE referred in NATURE of June 3 to the forthcoming sale of Stonehenge by auction. The property is under the protection of the Ancient Monuments Act, which ensures its preservation; and the auctioneers, Messrs. Knight, Frank, and Rutley, 20 Hanover Square, W., announce that Sir Cosmo Antrobus, who is only tenant for life, proposes, if his powers permit him to do so, to impose conditions providing for the public having access thereto for all time. It is hoped, however, that Stonehenge may be bought either by the Government or by a learned society, and if any reasonable proposal be made for its acquisition with the intention of preserving the monument in the public interest, the auctioneers are instructed to facilitate a sale by private treaty before the auction.

IN NATURE of May 20 we announced the death of Prof. P. Zeeman, since 1902 professor of geometry and theoretical mechanics in the University of Leyden. Prof. Zeeman was born at Hoorn (Holland) in 1850, studied in Leyden, and in 1882 became professor of mathematics at the Polytechnic School (now Technical High School), Delft, where he remained until his appointment at Leyden. He was the author of many contributions to geometry, and an admirable teacher and examiner, who won the affection of all his pupils and colleagues. Prof. Zeeman, of Leyden, has been confused with Prof. P. Zeeman, of Amsterdam. It may, therefore, be worth mention here that the professor of physics of Amsterdam is much younger than his late Leyden colleague, being born in 1865, and no near relative of the latter. Prof. Zeeman of Amsterdam also studied at Leyden, and there discovered in 1896 the magnetic separation of the spectral lines which bears his name. In 1897 he became lecturer, in 1900 professor, at Amsterdam; and in 1908 he succeeded van der Waals as director of the Physical Laboratory.

WE record with much regret the death on June 15, at eighty-six years of age, of Sir Nathaniel Barnaby, K.C.B., honorary vice-president of the Institution of Naval Architects, and formerly Director of Naval Construction. From an obituary notice in Wednesday's *Times* we extract the following particulars of his career and work. Nathaniel Barnaby entered Sheerness Dockyard as a shipwright apprentice when fourteen years old, and in 1848 gained one of the scholarships thrown open to competition among his class by the Lords of the Admiralty. He passed through the Portsmouth School with distinction, and was appointed a draughtsman in the Royal Dockyard at Woolwich in 1852. He was afterwards transferred to the Constructive Department of the Admiralty as a draughtsman; and for thirty years he remained in that department, rising to be its head in 1870, when Sir Edward Reed resigned his position of Chief Constructor. In 1872 he was definitely appointed to the position of Chief Naval Architect, a title which in 1875 was changed to that of Director of Naval Construction. In this position he continued with eminent success until 1885, when overwork caused a serious failure of health, and he decided to retire from the public service, being succeeded by the late Sir William White. After his retirement from the public service Sir N. Barnaby took, naturally, a less active part in questions of naval construction than previously. He was, however, often seen at the meetings of the Institution of Naval Architects, of which he was one of the founders, and the Transactions of which contain a number of papers from his pen, from the first volume onwards. Sir N. Barnaby was also the writer of articles of a technical character for the "Encyclopædia Britannica," and of several books on shipbuilding and naval development. He leaves a married daughter and a son, Mr. Sydney Barnaby, who holds the position of technical director and naval constructor with Messrs. Thornycroft.

AT the anniversary meeting of the Linnean Society on May 29 the following officers were elected:—*President*, Prof. E. B. Poulton; *Treasurer*, Mr. Horace W. Monckton; *Secretaries*, Dr. B. Daydon Jackson, Dr. Otto Stapf, and Prof. E. A. Minchin; *Council*, Mrs. Agnes Arber, Mr. R. Assheton, Dr. W. T. Calman, Mr. A. D. Cotton, Sir Frank Crisp, Bart., Mr. J. Groves, Prof. D. T. Gwynne-Vaughan, Prof. W. A. Herdman, Dr. B. D. Jackson, Miss G. Lister, Prof. E. A. Minchin, Mr. H. W. Monckton, Dr. C. E. Moss, Prof. E. B. Poulton, Dr. A. B. Rendle, Mr. H. Scott, Prof. A. C. Seward, Dr. A. E. Shipley, Dr. Otto Stapf, and Comr. J. J. Walker, R.N. The Trail award and medal for 1915 were presented to Dr. Leonard Doncaster, and Sir George Reid, G.C.M.G., the High Commissioner for Australia, received the Linnean gold medal for transmission to Mr. J. H. Maiden, of Sydney, New South Wales. At the general

meeting of the society on June 3, the president announced that he had appointed Mr. H. W. Monckton, Dr. A. B. Rendle, Prof. A. C. Seward, and Dr. A. E. Shipley vice-presidents for the ensuing year.

THE *Daily Chronicle* published on June 9 a long telegram from its New York correspondent, quoting from the New York *Tribune* the chief passages in a despatch from Mr. D. B. Macmillan, of Harvard University, the leader of the American expedition which has been at work to the north-west of Greenland since the summer of 1913. The main object of this expedition was to explore "Crocker Land," which Rear-Admiral Peary thought that he sighted from the north-west coast of Grant Land in 1906. The despatch now published was written a year ago, and the most important statement in it—that the appearance of land was seen in the direction indicated by Admiral Peary, but vanished as the explorers journeyed towards it, so that they concluded it was only a mirage—merely repeats information which was made known last winter through a despatch addressed to the American Museum of Natural History by Mr. W. E. Ekblaw, geologist and biologist to the expedition. Mr. Macmillan mentions that he has recovered records left behind by the Kane expedition and the Nares expedition. He also found in good condition milk and pemmican cached by Capt. Sverdrup twelve years ago. The work planned for this year included a journey by Mr. Macmillan himself for the exploration of the region south of the islands discovered by the Sverdrup expedition, and a journey by another party for the exploration of Greely Fiord and the Lake Hazen region in Grant Land.

THE death was recently announced of M. Pierre-Emile Martin in his ninety-first year. He was the first man to solve successfully the problem of making steel in an open-hearth furnace by melting pig-iron with iron oxide and scrap steel, his first patent being taken out in July, 1865. The actual discovery that steel could be made in this way was not new, for Réaumur had in 1722 carried out the same experiment, but only on a laboratory scale. Various metallurgists afterwards endeavoured to follow this method, but none of them were able to create a sufficiently high temperature in the melting hearth. M. Martin was the first to apply the principle of regenerative heating to his furnace, and in the early 'sixties he began experimenting with a Siemens furnace of one ton capacity at Sireuil in France. After numerous failures and disappointments, he at length succeeded in producing open-hearth steel of regular quality and composition, and his process was taken up by two of the leading French steel works. The success of the process attracted the attention of his competitors, and the validity of his patents was attacked on the strength of Réaumur's prior publication, although the latter had led to no practical result. Not having the financial means to defend the lawsuits brought against him, he was compelled, after two or three years, to give up the struggle and retire into private life, and for many years his existence was forgotten, although on the Continent the process was always associated with his name. A few years ago it became known that he was alive, and in June, 1910, at a banquet held in Paris, the steel-makers of Europe united to do him honour, and he was created by the French Government an Officer of the Legion of Honour. Ten days before his death the Bessemer medal awarded him by the council of the Iron and Steel Institute was handed to a representative of the French Embassy, who attended on his behalf at the spring meeting of the institute.

AT the shrine of the saint Sháh Daula at Gujrát in the Punjab the precincts of the building are occupied by a crowd of imbeciles who, from the elongated shape of their heads, are known as "Sháh Daula's Rats." Much interest has been shown in these curious creatures, and the question has been discussed whether this malformation is hereditary or artificial. In the June issue of *Man* Mr. M. Longworth Dames has collected references to the literature of the subject. From inquiries on the spot he finds them to be harmless, good-natured creatures possessing only primitive instincts and absolutely undeveloped minds. He concludes that the peculiar shape of their heads is the result of pressure applied by the mother that she may be able to devote her child to the saint to whom she owes the relief of her barrenness. He quotes an interesting account of such head-shaping from Mr. Bray's "Life History of a Brahui," and he believes, with good reason, that the practice is more common in Northern India than is commonly believed.

OF all the races of existing mankind, none is so interesting to the physical anthropologist as the Eskimo. No race possesses so many peculiar structural characters. In the last *Museum Bulletin* (No. 9, March 6, 1915) issued by the Canadian Department of Mines, Mr. F. H. S. Knowles directs attention to the peculiar form of the glenoid fossa and articular eminence in the skulls of Eskimo. The fossa is shallow, while the articular eminence is flattened and extended in a forward direction. The condition, in Mr. Knowles's opinion, is not unlike that seen in the skulls of Neanderthal man, and also, to a lesser degree, in the skulls of anthropoid apes. In most modern races of man, particularly in those living under the higher forms of civilisation, the glenoid fossa is deep and the articular eminence high and steep. Mr. Knowles seeks for an explanation of these contrasted forms of glenoid cavity in the nature of diet and in the movements of the lower jaw in mastication. As is well known, the diet of the Eskimo is particularly tough—the raw skin of whale, porpoise, and seal being looked upon as delicacies. Mr. Knowles regards the flattening of the articular eminence in the Eskimo, and also in Neanderthal man, as an adaptation to permit a free side-to-side movement of the jaw, such a movement being necessary for the proper mastication of tough substances.

WE have received from Mr. Johs. Schmidt a paper, printed in the *Comptes rendus des Travaux du Laboratoire de Carlsberg*, 1915, on the amount of lupulin in plants of the hop (*Humulus lupulus*, L.) raised by crossing. Detailed accounts of the crossing experiments are given, and the results are set out clearly in tabular form; 21 English, Danish, Austrian, and

German females, all cultivated plants, were crossed with wild Danish males, and the 744 resulting seedlings were investigated. Despite the fact that the wild males were presumably poor in lupulin, offspring variants having a higher lupulin percentage than the mother plant were produced. Improvement in this direction of higher lupulin content has thus been established, since the richest plants can be vegetatively propagated.

A PAPER of some interest on "The Influence of Temperature and Certain Other Factors upon the Rate of Development of the Eggs of Fishes," by A. C. Johansen and A. Krogh, has been published by the International Council for the Study of the Sea, as *Publication de Circonstance*, No. 68. By means of a specially designed thermostat the authors have kept the eggs of plaice and of cod at a series of different temperatures, and have recorded the time taken until the larva has reached a certain definite length. The main conclusion arrived at agrees with that reached previously by Dannevig, who had worked with less refined methods, namely, that the increase in rate of development with the temperature is proportional to the increase in temperature, or the curve expressing the relation between temperature and rate is a straight line. The authors have also studied the influence of low oxygen pressure upon the development of the eggs of plaice.

CAPT. S. A. WHITE, the President of the Australian Ornithologists' Union, is to be congratulated in having re-discovered a long-lost bird. This is the chestnut-breasted whiteface (*Aphelocephala pectoralis*), described originally from a single specimen by the late John Gould in 1871. Since then, all search for further specimens has proved unavailing, until Capt. White found it again, in small flocks, during an expedition to the Everard and Musgrave Ranges. Judging from the plumage of immature birds which he secured, he believes that this species interbreeds with the black-banded whiteface, which is highly probable, since the two species were often found in company. Capt. White gives an interesting account of his travels in the *Emu* for April. A camel-train furnished his means of transport, but throughout no small inconvenience was suffered by all the members of the expedition, including the camels, by reason of the prolonged drought, which, save for occasional and isolated showers, has now lasted for nine years in this region.

AN interesting article on the fur-bearing mammals of California, by Mr. H. C. Bryant, the game expert to the California Fish and Game Commission, appears in the April number of the new periodical, *California Fish and Game*. In a survey which dates back to 1786 the author traces the history of the ruthless and wasteful destruction of fur-bearing animals which has gone on without check until the present day. As a result some of the most valuable animals have been exterminated, while others are on the verge of extinction, a fate which can be averted only by instant and vigorous protective legislation. Among these is the sea-otter, which less than a hundred years ago was taken by the thousand; to-day no more than a few pairs are left. Some idea of the magnitude of the slaughter which is taking place may be gathered from the records of the total "catch" of last year in North America. This includes musk-rats 15,000,000, opossums 2,800,000, raccoons 2,400,000, skunks 2,152,000, minks 630,000, and "civet cats" (Bassaris) 500,000. To these must be added foxes, wolves, bears, otters, wolverines, pumas, wild cats, and martens, to the number of 1,500,000. Unhappily, the increased demand for furs is accompanied by a serious diminution in the area inhabited by the victims, owing to drainage and the destruction of forests. It is devoutly to be hoped that this appalling rate of destruction may be checked, at least, by the efforts which are being made to breed silver foxes and skunks for the sake of their skins. A number of "fur-farms" are already in a flourishing state, but so far their output is not sufficient to diminish materially the toll levied on the wild animals.

THE acid secreted by the gram plant, *Cicer arietinum*, forms the subject of Bulletin No. 45 of the Agricultural Research Institute, Pusa, and has been investigated by Mr. D. L. Sahasrabuddhe. The secretion which is used as a medicine in Western India has been found to consist of a mixture of malic and oxalic acids in the proportion of 94 per cent. of the former and 6 per cent. of the latter, and the secretion appears to be produced by the glandular hairs which occur especially upon the pods. The acids are collected by drawing a damped cloth over the gram plants and then wringing it into an earthenware vessel, and during the ninth to the eighteenth week of the plant's growth the yield of malic acid for an acre of gram was found to be 2686 gm., the cost of collection being about 14 rupees.

THE twisted fibres of the chir pine (*Pinus longifolia*, Roxb.) again forms the subject of an article in the *Indian Forester*. In the number for April (No. 4, vol. xli.) Mr. F. Canning deals with the matter as regards the east of Almora district. Twisting both left-handed and right-handed is found, and a very large proportion of trees are affected. At the base the twist is usually slight, and it becomes worse and worse higher up the stem, the maximum angle noted being 45° from the vertical. As to the distribution of affected trees, the relation to the geological conditions has not been observed, but aspect, fire, and proximity to villages do not appear to be correlated in any way with the occurrence of twist. Owing to the difficulty of detecting twisted trees in the young state, it may not be practicable to try to eliminate twisted fibre specimens in a sapling forest, though such trees are of very little value except for firewood.

THE Salton Sea in the Cahuilla Basin of California is described and illustrated by Mr. D. T. MacDougal in the *American Journal of Science* (vol. xxxix., p. 231). The work published by the Carnegie Institution was reviewed in NATURE (vol. xciv., p. 434, December 17, 1914), and this shorter account will be convenient for many who have not access to the publications of the institution.

MR. H. P. CUSHING (*American Journal of Science*, vol. xxxix., p. 288) criticises the view of Prof. W. J. Miller that the syenites and granites of the Adirondack region belong to one vast intrusive body, and maintains that here, as in Canada, there is an older group of orthogneisses which is intruded into the Grenville Series. This group has suffered severe regional metamorphism, and has been invaded by later rocks of the anorthosite-syenite group. The older orthogneisses may therefore be styled Laurentian, as in Canada.

THE expedition of Mr. F. B. Loomis from Amherst College to Patagonia resulted in his discovery, published in 1914, that Pyrotherium was a proboscidean. He referred the beds in which it occurred to the Oligocene. Mr. Carlos Ameghino ("Boletin de la Sociedad Physis," vol. i., p. 446, Buenos Aires, 1914) states that certain white sandy clays underlying the Pyrotherium beds, and recognised by Loomis as Cretaceous, are the strata that contain Notostylops, Notopithecus, and other mammals. Ameghino accepts a Cretaceous age for these, and believes that Pyrotherium is an early Eocene form. If this were proved, the ancestry of the proboscideans is to be sought, as Ameghino urges, in S. America rather than in Africa.

THE paper entitled "The Microspectroscope in Mineralogy," by Mr. Edgar T. Wherry, assistant curator of the division of mineralogy and petrology in the U.S. National Museum, which forms No. 5 of vol. lxv. of the Smithsonian Miscellaneous Collection, constitutes an important contribution to our knowledge of the absorptive properties of minerals. So long ago as 1866 Sir Arthur Church first noticed the existence of an absorption spectrum in zircon, but hitherto no systematic study has been made of the subject. Mr. Wherry has examined specimens of about two hundred minerals, and the results of his investigation are carefully tabulated. The analytical key given at the end of the paper should be invaluable to those making use of the method for determinative purposes. He found that better results were afforded by light diffused from the specimen than by light transmitted through it. The beautiful violet calcite from Joplin gives the neodymium absorption spectrum, and so do the yellow sphene from Switzerland and the brown apatite from Ontario. It is unexpected to learn that the colour of the violet-red almandine garnet is apparently due to vanadium. The presence of magnesium and manganese has no effect upon the colour of garnet. The bands shown by zircon are due to the presence of uranous uranium, usually in amounts of less than 0·5 per cent. The resulting blue colour is often masked by the other agents, such as iron or manganese. Brown or white zircons do not show a spectrum.

Symons's Meteorological Magazine for May gives the diurnal range of rainfall at Karlsruhe (Baden) and at Petrograd. The results have been obtained by Henrik Renqvist, Helsingfors, for the summer months June, July, and August from the published hourly values of rainfall. For Karlsruhe the observations dealt with are for twenty-two consecutive years, from 1892 to 1913 inclusive. Percentages of the total fall are given for each interval of four hours. The highest percentage value is 22·0 for 4 to 8 p.m., and the lowest 12·2 for 8 a.m. to noon. The results for Petrograd are for the twelve years 1897 to 1908, and have been dealt with in the same way. The highest percentage is 22·3 for noon to 4 p.m., and the lowest 13·3 for 4 to 8 a.m. Both stations are fair representatives of the Continental type, and show a maximum in the afternoon and a minimum in the morning. Karlsruhe is said to have a diurnal range of rainfall highly resembling that of Perpignan, for which the percentages are given. Petrograd shows great similarity to Kew, the results for which are given from "The Diurnal Range of Rain," issued by the Meteorological Council.

THE *Journal of Agricultural Research*, iii., 5 (Washington), is scarcely the place in which one would expect to find a paper on fitting logarithmic curves by the method of moments. The use of logarithmic curves would appear to be desirable for tabulating biological statistics, and the object of the paper is to determine the constants when the formula assumed is of the form of a quadratic function plus a logarithm. Mr. John Rice Miner determines these constants in terms of the area and first two or three moments of the curve, but unfortunately the formulæ are very laborious in the carrying out, and it would certainly appear desirable to simplify them.

THE Journal of the Washington Academy of Sciences for May 19 contains a short account of a new calorimeter due to Messrs. H. C. Dickinson and N. S. Osborne, of the Bureau of Standards. The calorimetric substance is a block of copper in which are embedded a platinum resistance thermometer and a coil of resistance wire for supplying heat to the block electrically. A number of test experiments on the specific heat of water show that a degree of accuracy of 1 part in 2000 may be obtained with the calorimeter. The specific heat between $-40°$ C. and 0° C. and the latent of fusion of ice at 0° C. have also been determined with the apparatus. The results for the specific heat are given by the expression $0{\cdot}5057+0{\cdot}00186\theta$, where θ is the temperature Centigrade, and for the latent heat 79·76 in terms of the gram-calorie at 20° C. The latter figure is in close agreement with the value 79·74 previously obtained at the Bureau by other methods, so that it seems probable that the mean 79·75 may be accepted as a close approximation to the true value of this important constant.

M. ERNEST COUSTET contributes to *La Nature* of May 22 a useful article on the dosage of X-rays. He admits that the mere observation of the current traversing the X-ray tube is apt to be very misleading. Better results are given by comparing the fluorescence produced by the rays with the fluorescence produced by a radium bromide standard. This method implies a careful observation of the time of exposure, a necessity which is avoided by the various "chromometers" devised by Holzknecht, Bordier, Sabouraud, and Noiré, in which the dose is estimated by the coloration of sodium chloride or bromide, or of barium platinocyanide. Since, however, the estimation of tints does

not admit of any great accuracy, some ionisation method appears preferable, such as is employed in Villard's X-ray counter, in which an electroscope is discharged a number of times. It then remains to measure the "hardness" of the rays, or their penetrating power, and this may be done by Benoist's "radiochromometer," consisting of a ring of aluminium strips of twelve different thicknesses. There is still, however, much room for improved methods of dosage.

MR. JAMES KEITH directs attention in the *Engineer* for June 11 to the use of cast-iron shells of fairly large calibre by the Germans. Mr. Keith suggests that, whether or not there be any particular reason for our keeping to expensive steel shells, there could surely be no harm in our having cast-iron ones as well to fill up the gaps, and so enable innumerable shells to be at the service of the armies of the Allies. The matter is taken up by our contemporary in a leading article, and the objections to the course suggested by Mr. Keith are discussed fully. In shrapnel cast-iron shells, the number of bullets is reduced because the walls of the shell must be made much thicker. In high-explosive shells there is such danger of a cast-iron shell developing cracks during manufacture that high explosives cannot safely be used in them. Further, projectiles must be perfectly in balance; the walls must be of uniform thickness all round, and must be of homogeneous material. Otherwise accuracy in shooting would be destroyed. Lastly, the methods of manufacture of steel shell have been so developed that such shell can actually be turned out more quickly than those of cast-iron of equal trustworthiness and accuracy. An 18-pounder shell can be completely machined from the bar in about forty minutes. The *Engineer* suggests that the use of cast-iron by the Germans indicates that they are finding their supplies of modern projectiles not inexhaustible under the tremendous drain that is being put upon them.

MESSRS. LONGMANS AND CO. announce for early publication "The House Fly: a Slayer of Men," by F. W. Fitzsimons, director of the Port Elizabeth Museum. The volume will be illustrated. The author has worked for several years at the destruction of the house-fly in South Africa.

OUR ASTRONOMICAL COLUMN.

BEHAVIOUR OF SPECTRUM LINES OF THE SAME SERIES.—The lines in a series are generally assumed to behave alike (omitting reversals), even under varying experimental conditions. In fact, their sharpness, diffuseness, or direction of unsymmetrical widening have been used as criteria in the detection of series relationships. Thus if the strong lines of a series were unsymmetrically widened towards the red the remaining lines of the series would be expected to be widened in the same direction. This, however, is not the case, and an investigation bearing on these points is communicated by Dr. Royds to the forty-third Bulletin of the Kodaikanal Observatory (see also the *Astrophysical Journal*, March, vol. xli., No. 2, p. 155). In the case of the barium lines he finds that all the first members of the first subordinate series are displaced to the red, and the second members to the violet. In the case of the calcium series he finds this not so extreme a case as that of barium, but still a noteworthy exception to the general run of series. The strontium series, on the other hand, is stated to be quite normal if the infra-red lines the character of which is unknown are excepted. Dr. Royds directs attention to the whole question of the relationship between pressure shifts and series, since the pressure shift may even be in opposite directions for lines of the same series. He points out, further, the importance of isolating the pressure effect from the density effect, the elimination of the latter in order to obtain true pressure shifts being "one of the most pressing problems for those interested in the displacements in the sun's spectrum."

THE FISHER, POLK COUNTY, MINNESOTA, METEORITE.—In the *American Geologist* for December, 1894, brief mention was made of the finding near Fisher, Polk County, Minnesota, of a meteoric stone weighing nine and a half pounds. This stone, the first found within the State limits, was assumed to be a representative of a reported fall which took place on the 9th of the preceding April. In a subsequent number of the *Geologist* a petrographic description of the stone was begun by Prof. N. H. Winchell, but this was neither completed nor was a satisfactory chemical analysis made. In view of these facts and also because more parts have been subsequently found, a complete review of the whole matter has been undertaken by Prof. G. P. Merrill, and the results are published in No. 2084 Proceedings of the United States National Museum (vol. xlviii., pp. 503–6, May, 1915). It seems that specimens of this fall are distributed in eight different collections, the four largest portions being in institutions in Minneapolis, Washington, New York, and Hamburg; the total weight of all the known portions amounts to 9900 grams. The author has been offered facilities for examining and taking samples for the purposes of identification and chemical analysis, and in this paper he publishes the results of his inquiry. Following Brezina's classification he places the stone in the group of intermediate chrondites Ci, or perhaps Cia, as one cut surface shows a small thread-like black vein.

THE NANTUCKET MARIA MITCHELL ASSOCIATION.—In the thirteenth annual report of the Nantucket Maria Mitchell Association, an account is given of the astronomical work accomplished during the past year. This association completed in 1911 the Astronomical Fellowship Endowment Fund, and the first fellow was appointed in the following year; the second has just been nominated. This fellowship enables the holder to avail herself of the entire year for study and research in an observatory of her own selection. Miss Annie J. Cannon, the chairman of this special committee, describes briefly the work of the association with the new 7½ in. photographic telescope. After the adjustments were completed numerous photographs were taken, chief of which were of the minor planet Eros. These plates are now being measured by the first fellow, Miss Harwood, at the Harvard Observatory, together with the plates of the same asteroid taken at that observatory. The chief research will be the photographing of each asteroid once a month for as long a period as possible, the selected objects being those for which the ephemeris at opposition is given in the Berlin *Jahrbuch*.

RECENT BULLETINS OF THE ASTRONOMICAL SOCIETY OF FRANCE.—The April and May numbers of the valuable Bulletin of the Astronomical Society of France have come to hand in spite of the difficulties under which

such a publication is produced. The publishers, in a special note, direct attention to these difficulties, and say that the Astronomical Society of France, confident in the triumph of right and of civilisation, pursues, by the publication of this monthly Bulletin, its work of instruction and scientific propagation with untiring energy, and counts on its adherents to forward at once their subscriptions for the current year. The two issues mentioned above contain numerous communications of interest, among which may be mentioned the first observations of the transit of Mercury, an episode in the life of François Arago, an address by Monsieur C. Flammarion, delivered at the annual general meeting of the Society on April 11 of the present year, and a summary by Comte de la Baume Pluvinel, at the same meeting, of recent discoveries in astronomy. The application of selected filters to the study of Comet Delavan is described by Mentore Maggini, being a summary of a research he undertook in the year 1913.

IRON, CARBON, AND PHOSPHORUS.

DR. J. E. STEAD'S knowledge of iron-carbon-phosphorus compounds is so remarkable, and indeed so unique, that the recent meeting of the Iron and Steel Institute in London was rendered memorable by his presentation of a most illuminating paper on this subject. As a matter of fact, the word "paper" is an inadequate description of the publication, which is very composite in character and deals with some ten aspects of the iron-carbon-phosphorus equilibrium; most of them practical, some of them purely scientific.

The constitutional diagram of the iron-carbon-phosphorus alloys is not yet completely known. The studies of Stead, Wüst, and Goerens have established with sufficient accuracy the liquidus fields of that part of the triangular diagram the corners of which are represented by iron, iron phosphide, Te_3P, and iron carbide, Te_3C. The compositions of the three "binary eutectics" are known, as is also that of the ternary eutectic, which contains 91·19 per cent. of iron, 1·92 per cent. of carbon, and 6·89 per cent. of phosphorus, and freezes at about 950° C. But, in spite of the fact that the paper under notice contains much new and interesting information about some of the solid phases and their relations between the solidus and the ordinary temperature, we are still without accurate knowledge of the composition of most of them and their variation with varying temperature. The constitutional diagram below the solidus has still, for the most part, to be determined, and until this has been done the interpretation of a good many of Dr. Stead's results can only be provisional.

In some earlier experiments Dr. Stead squeezed a portion of the ternary eutectic out of grey Cleveland iron by pressure. The amount extruded, however, was only a small fraction of the total quantity present, for the mould was not maintained, as it would have had to have been, at a temperature just above the freezing-point of the eutectic. It appears, however, that the requisite temperature and pressure conditions are realised in the formation and very slow cooling of the so-called "blast furnace bears." These are accumulations of grey iron which gradually form underground below the well or crucible of the furnace, and sometimes attain an enormous size. One of these dug out from beneath one of the Skinningrove furnaces weighed between 500 and 600 tons. The circumferential contraction of this large mass on cooling compressed the central portion, which was the last to freeze. According to Dr. Stead, "the effect of this enormous pressure caused the central plastic mass to assume a vertical column, an arrangement closely resembling on a small scale the basalt of Giants' Causeway." These columns could be separated from one another. Chemical analyses indicate that about 90 per cent. of the phosphorus originally present had been extruded vertically between the columns during the period of intense compression. A "bear" with a similar columnar structure has also been found in the hearth of a Cleveland furnace of Messrs. Bolckow, Vaughan and Co. at Eston. Here, too, the columns were all vertical, and varied from $\frac{1}{8}$ to $\frac{1}{4}$ in. in diameter, and in some places were so loosely attached to each other that they could be separated by hand. These also were found to be low in phosphorus. In the case of a bear under an Ormesby furnace which had been in blast some thirty-eight years, about two-thirds of the original phosphorus had been removed, but there were no indications of columnar structure. On the other hand, the metal found in the hearth of one of the furnaces at Ferryhill consisted of columnar crystals of iron saturated with iron phosphide, with walls of iron phosphide, but entirely free from carbon and silicon. Here, therefore, the conditions must have been much more oxidising, and no ternary eutectic was present. It is, however, abundantly clear that by far the greater part of the phosphorus in highly carbonised iron is concentrated in the last portions which freeze.

Two photographs reproduced in Dr. Stead's paper illustrate the structure and mode of occurrence of the ternary eutectic extremely well. Both were developed by heat-tinting, iron phosphide appearing blue or purple, iron carbide red, and iron saturated with phosphide white. No. 1 is termed by Dr. Stead the "normal" structure, and is clearly lamellar, recalling the well-known pearlite in its form; No. 2 is evidently that of a very slowly cooled specimen, the lamellæ having coalesced to an appreciable extent.

The equilibrium relations between iron, iron carbide, and iron phosphide in the range of temperature 1000° C. to 700° C. are of the utmost importance in the light they shed on the so-called "ghosts" or "phantoms," which are very liable to occur in large forgings of mild or medium steel. These are lines or streaks which can only be detected after rough turning. As the names indicate, they are not deep-seated. They are completely removed by turning off a thin layer of the steel, but are liable to reappear in other places. It is clear, therefore, that they are very attenuated and irregularly distributed. The usual view held is that they are harmful, and forgings are sometimes rejected on account of their presence, in spite of the undoubted fact that some of them have proved satisfactory in service even though such ghost lines were present. Their occurrence, in Dr. Stead's view, is due to the fact that "in steels containing 0·45 per cent. and less carbon, although the carbon may be equally distributed when the steel is at 1000° C., on very slow cooling the ferrite first appears in the parts richest in phosphorus. The portions which are partially saturated with phosphorus cannot so readily hold in solid solution at certain temperatures as much carbon as the surrounding portions which contain little or no phosphorus; consequently, when in cooling it reaches these temperatures, the carbon diffuses out of the phosphorised parts into the surrounding pure metal." These areas of phosphide concentration constitute the ghosts, and, as sulphides and phosphides segregate together, sulphides are generally present in them as well.

Dr. Stead has succeeded in producing typical ghost lines synthetically by heating to 1000° C. strips of soft

iron sandwiched with ternary eutectic and then forging down to a ¼-in. sheet. This treatment squeezed out the excess of eutectic and left the juxtaposed faces perfectly united with a thin layer rich in phosphorus. After very slow cooling, sections were cut, polished, and etched. The structure was found to consist of "strings of disconnected patches of pearlite and straight lines of ferrite," very similar to those found in ship and boiler plates. All the carbon originally present in the eutectic was found to have diffused into the iron beyond the phosphoretic junctions Heating to 1350° C., however, followed by a three days' cooling period to 700° C., caused a uniform distribution of the carbon and phosphorus in the steel.

Dr. Stead's general conclusion is: "After careful study I am inclined to believe that if they"—*i.e.* ghost lines—"are not associated with a material amount of slag inclusions, they are not dangerous or liable to lead to the failure of engineering structures. I am led to that conclusion by submitting cross-sections to violent shock test, so that the stress applied is greater across the lines; for when this is done fracture does not start where they are located unless there are sulphide or slag inclusions in material quantity. The subject should have more consideration, and be thoroughly investigated by making suitable mechanical tests."

Only two aspects of Dr. Stead's publication have been touched upon in this article. The complete paper, however, should be studied by those who are interested in the presentation of the subject in a series of masterly and informing sub-papers which no one but he could have written.

H. C. H. CARPENTER.

THE SEISMOLOGICAL SOCIETY OF AMERICA.

FOUR volumes of the Bulletin of this society were completed with the last year. They contain many papers of interest and value, most of which have been noticed in these columns, and several —evidently the work of novices—which the Publication Committee might with advantage have suppressed.

The first part of the fifth volume, which has been issued recently, contains six papers, three of which are of general interest. Of the others, one on the seasonal periodicity of earthquakes is inconclusive. Mr. Carl H. Beal describes an earthquake which originated near the town of Los Alamos, in south-western California, on January 11 last. This is probably the first earthquake in which the long-distance telephone has been used in the collection of records. Prof. J. C. Branner insists on the untrustworthiness of personal impressions on the direction of an earthquake-shock, and he urges that, in investigations of an earthquake, the question dealing with such impressions should be omitted. It has long been known that single observations on the apparent direction of the shock or on the fall of a column, etc., are valueless, the apparent direction being almost invariably perpendicular to the principal walls of the house in which it is observed. But the average of a large number of personal observations within a limited area has been found in several cases to coincide with the direction of the area from the epicentre. Moreover, after the Tokyo earthquake of June 20, 1894, Prof. Omori measured the direction of fall of 140 stone lanterns with circular bases in Tokyo, and the average of these measurements coincides exactly with the direction of the single great oscillation registered in that city.

The first place in the number is given to Mr. Carl H. Beal's account of the Avezzano earthquake of January 13. The material of this paper is derived chiefly from newspaper reports and from a short article which appeared in NATURE (vol. xciv., p. 565), but the author adds an interesting note with regard to the origin of the earthquake. "The higher mountain ranges near Avezzano," he says, "rise to an altitude of from 6000 to 7000 ft. and trend generally north-west and south-east, the direction apparently being determined by a series of nearly parallel fractures which extends from a region south-east of Avezzano north-west to the vicinity of Cittaducale. . . A fault is known to pass through Luco, Cappelle, Sourcola, and very close to Avezzano, and as these cities were completely demolished, it is quite probable that movement along this fracture caused the shock."

On November 8, 1914, a fairly strong earthquake was felt in central California. From the duration of the preliminary tremors at Berkeley, and from the initial times at Santa Clara and the Lick Observatory, and taking the velocity for the tremors at Zeissig's value of 6·3 km. per sec., Mr. E. F. Davis finds that the epicentre was situated on the San Andreas Rift, close to the town of Laurel. From a study of the distribution of intensity, Mr. Carl H. Beal had previously assigned approximately the same position for the epicentre. The San Andreas Rift is the great fault along which for 270 miles the movements took place which gave rise to the Californian earthquake of 1906.

Since 1832, there have, according to Mr. H. O. Wood, been twenty-five eruptions of Mauna Loa, in the south of Hawaii. With the majority of these no earthquakes are recorded, and this might also have been said of the last eruption which began on November 25, 1914, had it not been for the instrumental record of a large number of feeble shocks. Mr. Wood concludes that "nothing appears in the sequence of events which would have justified confident, or definite, *prediction* of outbreak," though the numbers of shocks recorded during the five preceding weeks were one, five, sixteen, thirteen, and thirty-eight.

C. DAVISON.

INDIAN GEODESY.[1]

THE two volumes referred to below supplement one another, for while the general report gives an abbreviated account of the year's work, more detailed descriptions and the discussions of the results obtained find their place in the Records.

Pendulum observations were made at fourteen stations between lat. 20° N. and lat. 30° N., all in the immediate neighbourhood of the 78th meridian, thus filling in the gap which existed between Lieut.-Colonel Lenox-Conyngham's work from Mussoorie to Meerut, and that of Captain Cowie in the Central Provinces. The stations include that of Kalianpur, the station of origin of the Indian triangulation, and here the pendulums were swung in the same room where Captain Basevi swung his pendulums in 1867. At Dehra Dun the new pendulum room was used. Some changes have been introduced in presentation of the results; Helmert's formula of 1901 is employed instead of that of 1884, which had been used previously; also the formula for the mass correction has been modified by taking somewhat smaller values for the mean surface density of the

1 "General Report on the Operations of the Survey of India during the Year 1912–13." By Colonel S. G. Burrard, C.S.I., R.E., F.R.S. (Calcutta, 1914.)
"Records of the Survey of India." Vol. v., Reports of Survey Parties, 1912–13. (Calcutta, 1914.)

earth and the mean density of the earth as a whole, viz.: 2·67 and 5·576, in place of 2·8 and 5·66.

In August, 1913, two members of Dr. de Filippi's Karakoram Expedition swung their pendulums at Dehra Dun, and thus a new independent value for gravity at Dehra Dun will be obtained when the expedition has returned to Genoa.

No officer being available, the determination of astronomical latitudes was not undertaken during this season.

Work was carried on in the principal triangulation, and twenty-two triangles of the Sambalpur series were observed, the standard of precision being well maintained in spite of the difficult and inhospitable character of the country traversed. A network was also observed as the control for a large-scale survey of Bombay island, and as a further stage a traverse network of considerable precision was utilised. Permanent marks were placed on brass plugs which were built into masonry a foot below ground, and a special device was introduced for accurately centring the theodolite over the mark. Linear measurements were made with a 100-ft. steel tape, which was strained by means of weights suspended over pulleys. The precision of the lines of the traverse network when adjusted to triangulated points is given as 1 in 12,000.

Some 180 miles of the Indo-Russian triangulation connection, which had been reconnoitred in the previous year, were observed, and the work satisfactorily concluded.

In levelling details are given of carrying lines, of levelling across rivers, both by the "target" and by the "vertical angles" methods, and their respective advantages are discussed.

In the winter of 1912–13 a delimitation of the boundary between Nepal State and Naini Tal district was carried out. The boundary consisting of three straight lines joining four predetermined points in forested country, it was found most convenient to run an accurate traverse near and approximately parallel to the boundary line, so that from the traverse points could be located on the boundary line, and be determined. The result was quite satisfactory, and boundary pillars were erected along the line.

Dehra Dun having been dispensed with as a meteorological station, the forenoon and afternoon observations have been discontinued, and others at 2 p.m. (standard time) have been substituted. With similar simultaneous observations taken at Mussoorie, it is hoped to gain information bearing on terrestrial refraction which will be useful in the work of the survey.

Besides the points which have been mentioned there is much detailed information of value and importance to surveyors and geodesists in these volumes, which represent a large amount of work of a high standard carried out during the period under review.

H. G. L.

THE FLY PROBLEM.

IN a pamphlet published by the Zoological Society, entitled, "The Fly Campaign," and in a public lecture delivered at the Zoological Society's offices, Prof. Lefroy has dealt with the problem of the house-fly and its allies, less from the purely scientific point of view than from the practical and economical aspect.

The pamphlet discusses flies generally, their importance and occurrence; the life-history of the house-fly is dealt with in detail; the eggs and where they are laid, the maggot, its habits, appearance, and its migration; the pupæ, the adult, its appearance, food, reproduction and the total period of its life.

A separate section describes the feeding habits of the fly, to show why and how it is such a carrier of disease, and what a repulsive intruder it is to houses; the hibernation and flight of flies is separately discussed, and a section deals with other flies than the house-fly which are found in houses.

Dr. C. J. Martin has written a section on flies as carriers of disease, which need not be summarised in view of the article on this subject in NATURE of May 13.

The pamphlet then deals with "Methods of Destruction," including the treatment of "tips" and manure, the protection of hospitals and houses, and the use of fly-traps. It concludes with a bibliography.

In his lecture at the Zoological Society's offices on June 2 Prof. Lefroy illustrated his remarks with lantern slides, largely made from the posters and illustrations used in the Fly Exhibition at the Zoological Society's gardens; these bring home vividly what flies do, how they actually feed, what the connection is between the fly feeding on human excreta and the spread of typhoid or summer diarrhœa.

In the lecture Prof. Lefroy expressed his personal opinion on many points, and especially on the question of the treatment of manure. Elaborate experiments are in progress, and already a method has been obtained which is one-third the cost of borax and water, and of far more general application. Naturally this has to be elaborately tested, but the lecturer was extremely hopeful of a solution of this problem, by far the most important in regard to the prevention of flies.

Equally elaborate experiments are in hand with regard to baits, with great promise of success; and success means a good bait that may be obtained and used in the campaign this summer.

Prof. Lefroy's lecture was illustrated by more than sixty lantern slides, many made from large wall pictures prepared for the Fly Exhibition by Miss Bertha Reid. Arrangements have been made to reproduce the lecture with the slides at any town in England that wishes it. The exhibition at the Zoological Society's gardens is popular, and will bring home to many the importance of flies and the simple ways of dealing with them.

JAMAICA AS A CENTRE FOR BOTANICAL RESEARCH IN THE TROPICS.

NO botanist should be content until he has visited some tropical area, and studied its flora on the spot. The tropical region most readily accessible from Great Britain lies in the West Indies; and as Jamaica now offers special facilities at the Cinchona station, recently leased by the Jamaican Government to a committee of the British Association, the time is opportune for explaining the advantages it can provide.

The public gardens controlled by the Jamaican Department of Agriculture are seven in number. Of these only three are botanic gardens in the strict sense, viz., the Hope Gardens near Kingston, the Castleton Garden, and the Cinchona Plantation, or Hill Gardens, in the Blue Mountains.

The first of these lies on the Liguana Plain, just beneath the foothills of the Port Royal range, at an elevation of 650 ft., and about six miles from Kingston. It comprises an area of 200 acres, with a mean annual temperature of 76° F., and average rainfall of 54·5 in. The gardens contain a large and varied collection of typical plants of the tropics, together with economic and ornamental plants, and many species of academic interest. The office, which constitutes the headquarters of the Agricultural Department, contains a good working library, and an in-

valuable herbarium representative of the Jamaican flora. These, together with the willing help of the superintendent, Mr. W. Harris, greatly facilitate determinations of species. The laboratories of the island chemist and of the Government micro-biologist, where, by the courtesy of the Government, reagents may be purchased at cost price, are located within easy reach of the gardens.

Castleton Garden occupies a tract of undulating ground on the left bank of the Wag-Water River, nineteen miles north-west of Kingston, on the road leading to Annotto Bay on the north coast. The average elevation of the garden is 500 ft., the annual mean temperature is 76° F., and the average rainfall 117 in. Though much smaller, and from an economic point of view less important than the principal garden at Hope, Castleton is, if anything, of greater interest to the botanical visitor. The climatic conditions are highly conducive to the growth of luxuriant vegetation; for not only is the rainfall more than twice as high as at Hope, but the atmospheric humidity is also far greater, particularly at night time, the dews being extraordinarily heavy. One of the most striking features of the garden is the collection of palms grouped artistically around a centre water-lily pond. Other families of Angiosperms that are particularly well represented are the Moraceæ, the Cæsalpinioid, and other Leguminosæ, and the Lecythidaceæ. Groups of Cycads and of Marattiaceous and Cyatheaceous ferns, bamboo-groves, clumps of tall Scitamineæ, Aroid root-climbers, and the ubiquitous epiphytic Bromeliads and epiphyllous Lichens and Hepatics are other prominent elements in a thoroughly tropical scene.

The Hill Gardens—formerly the Cinchona Plantation, and still generally known as Cinchona—are placed on one of the southern spurs of the Blue Mountains, at an altitude of 4900 ft. As the crow flies, they are about fifteen miles from Kingston, in a northerly direction; but by road the distance is somewhat greater. The scenery, especially on the latter part of the route, is beautiful in the extreme, and the vegetation varied and interesting, although up to about 4000 ft. it has been considerably modified by cultivation.

The Hill Gardens were at one time the headquarters of the botanical department, and the centre of extensive Cinchona plantations, but are now the least important, economically, of the agricultural and botanical stations maintained by the Jamaican Government. The garden proper lies on the steep terminal slope of a spur, which projects in a southerly direction from the central chain of the Blue Mountains, at a point situated nearly midway between the two high passes known respectively as Morce's Gap and Newhaven Gap. Except to the northward, where the ground rises steeply for some distance, magnificent views are obtained in every direction. Due south, one looks across the deep Yallahs valley, over the Port Royal Hills, towards Kingston Harbour, the great Palisadoes reef, which forms its natural breakwater, and the open sea. On the west and southwest, John-Crow Peak and Catherine Peak stand out prominently above many lesser hills. Eastwards, beyond the Green River valley, rise Sir John Peak (6100 ft.) and the twin summits of the Blue Mountain Peak (both more than 7000 ft.), the latter almost always wrapped in mist except at dawn.

The Cinchona dwelling-house is a substantial single-storey building, of bungalow type, containing two sitting-rooms and four bedrooms, besides kitchen, scullery, and servants' quarters. It is this house that is now let to a committee of the British Association, and would be available for scientific visitors. It is furnished and kept in excellent repair, and is cleansed and aired at regular intervals, so as to be ready for occupation at any moment. Close by are four or five wooden sheds, two of which stand on the same terrace as the house, the rest being situated at a somewhat higher level. These were formerly utilised as offices and store-rooms, and are well adapted to serve as laboratories for morphological or physiological work. The largest shed has bench and window space amply sufficient for the needs of half a dozen workers. At present there is no supply of running water in connection with any of these outhouses, as the highest of the existing storage tanks lies approximately at the same level as the floor of the large shed, and is only connected to the dwelling-house. But it would be a simple matter to lay down a tank further up the hills, from which pipes could be carried to any of the sheds. Cinchona is fortunate in possessing an almost ideal climate. The annual mean temperature is 62° F., the mean variation only 12° F. The rainfall is high, amounting to 104 in.; but, during the summer months, at any rate, this precipitation chiefly takes the form of heavy thunder-showers, which fall in the middle of the day, and are usually followed by delightfully fresh, sunny evenings. The nights are always cool, and often indeed decidedly cold.

Like the Port Royal Hills, the Blue Mountains are, on their southern side, cultivated up to about 4000 ft.; from that level upwards they are clad in a dense covering of virgin forest which extends up to the highest summits. As already stated, the cultivation of Cinchona trees was at one time carried on upon a large scale on the slopes around the Hill Gardens. At the present day scarcely any traces of these plantations remain, and the hillsides are rapidly returning to their natural condition. A large amount of botanical material of general interest can therefore be collected in the immediate vicinity of the gardens.

A pleasant walk of three miles from Cinchona, along a level path—a rare luxury in these hills—brings one to Morce's Gap, the most frequented pass over the main ridge. Rather more than half-way from Cinchona to the gap, the somewhat scrubby growth covering the site of the old plantations gives place to evergreen dripping-forest of the most luxuriant description. The dominant trees are for the most part thin-stemmed, and of moderate stature. They are set closely together, and the leaf-canopy overhead is very dense. Hence from the greater part of the interior of this forest sunlight is altogether excluded, and even the diffuse illumination is greatly reduced. The undergrowth is on the whole markedly hygrophilous in character. It is everywhere largely composed of shade-loving ferns. In every respect, indeed, ferns constitute a very important and conspicuous element on the forest flora. Alsophilas, Cyatheas, and Hemitelias rear their splendid crowns of foliage on stems 30 or 40 ft. in height. Lomarias and Davallias climb high on the tree trunks, or straggle over the bushes. On the steep slopes are groves of the remarkable *Lophosoria pruinata*, or impenetrable thickets of Gleichenia. The numerous small stony gullies harbour many forms of special interest, such as *Marattia alata*, *Danaea alata*, and *Pteris podophylla*. Among the rich and varied epiphytic flora of these woods ferns likewise play no mean part, the Hymenophyllaceæ in particular being represented by many exquisite forms. The phanerogamic undergrowth, in so far as it consists of shrubs, is particularly rich in Rubiaceæ and Melastomaceæ; the commonest herbs are species of Peperomia and Pilea. Climbers are fairly plentiful, but few of them are woody, a notable exception being *Marcgravia umbellata*, old stems of which attain a very considerable

girth. Epiphytes are exceedingly abundant, especially Bromeliads and Orchids, the former excelling in numerical strength, the latter in number of species and variety of form.

There are many excellent collecting grounds in the neighbourhood of Cinchona, such as the valley of the Mabess River to the north, Sir John Peak (both above Newhaven Gap, and below that pass, along the Latimer River), and various localities near Catherine's Peak, as well as the slopes of that mountain itself.

The preceding remarks may have served to give some idea of the merits of Cinchona from a strictly botanical point of view. There are many other places in Jamaica, such as the John Crow Mountains, Holly Mount, Mount Diablo, and, above all, the almost unexplored "cock-pit country," which are undoubtedly rich in botanical interest.

It may be worth while to point out that in regard to such considerations as personal safety and comfort, cost of living, and facilities for transport, Jamaica generally, and Cinchona in particular, compare very favourably indeed with other botanical stations in the tropics. Even in Kingston, the refreshing sea and mountain breezes, and the cool nights, render the heat quite supportable in the height of summer. In fact, Jamaica must be considered distinctly healthy, the death-rate for the whole island having been only 22 per 1000 in 1912. In the mountains there is no risk of contracting any tropical disease. Anywhere in hot countries the nature of the water supply is a matter requiring the most careful consideration. Cinchona is, however, singularly fortunate in possessing a source of drinking water which is above suspicion. The island is quite free from large carnivora and venomous snakes; indeed, the only noxious animals of any importance, apart from mosquitoes, are scorpions; although ticks are, in some seasons and localities, a source of discomfort.

The double journey, from England to Kingston and back, occupies from four to six weeks, and costs 35*l*. to 55*l*. according to the route selected. Any botanist who is prepared to set aside a summer vacation for the purpose can enjoy from seven to nine weeks in this delightful island at a total cost of well under 100*l*. The agreement recently signed for the annual tenancy of the Cinchona Bungalow between the Jamaican Government and a committee of the British Association has had the effect of making the house available for botanists and others. Application for its use may be made (with suitable credentials) to the chairman of the committee (Prof. F. O. Bower, University, Glasgow). Unfortunately, the outbreak of war during the first year of the tenure may prevent the opportunity being used. But the object of this article is to make the fact more fully known, and to show that while the scientific attractions of Cinchona are great, the risks are negligible. Cinchona is probably the safest, as it is also the nearest, point to Great Britain where a tropical flora can be studied in something approaching the virgin state; and a visit of quite useful length can easily be fitted into an ordinary summer vacation. M. D.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held in Philadelphia on April 22–24. The meeting was opened by President W. W. Keen, who, with Vice-Presidents A. A. Michelson, W. B. Scott, and Prof. C. L. Doolittle, presided over the various sessions.

On the evening of April 23 a reception was held in the hall of the Historical Society of Philadelphia, at which Dr. W. M. Davis, emeritus professor of geology, Harvard University, gave an illustrated lecture on new evidence for Darwin's theory of coral reefs. The lecture described the chief results of a Shaler Memorial voyage across the Pacific in 1914, with studies of the Fiji group, New Caledonia, the Loyalty Islands, the New Hebrides, the Great Barrier Reef of Australia, and the Society Islands (see NATURE, April 15, p. 189).

On the afternoon of April 24 a symposium was held on the figure, dimensions, and constitution of the interior of the earth. The subject was discussed from the astronomical point of view by Dr. Frank Schlesinger, director of Allegheny Observatory, Pittsburgh; from the geological point of view by Dr. T. C. Chamberlin, head of department of geology, University of Chicago; from the seismological point of view by Dr. H. F. Reid, professor of dynamical geology and geography, Johns Hopkins University, Baltimore; from the geophysical point of view by Mr. J. F. Hayford, director of the College of Engineering, North-western University, Evanstown, Ill.

Abstracts of a number of the papers read during the meetings have reached us from Philadelphia, and the following brief *résumé* has been compiled from them. In the case of most of the papers, the titles alone were given in the report sent to us, but we have omitted these as not providing information of interest.

Prof. E. P. Adams, Princeton University: "The Hall and Corbino Effects."

The Hall effect is the production of a transverse difference of potential in a conducting sheet when an electric current flows through it and it is placed in a magnetic field perpendicular to its plane. The Corbino effect is the production of a circular current in a conducting disc when a radial current flows through it and it is placed in a magnetic field perpendicular to its plane. Experiments made to study the latter effect and to show its essential relation to the Hall effect are described. The symmetry of the experimental arrangement for measuring the Corbino effect, as well as the fact that the measurement of the Hall effect requires very thin sheets, gives to the Corbino effect an important position among galvano-magnetic effects.

Dr. C. F. Brush: "Spontaneous Generation of Heat in Recently Hardened Steel."

The author shows that the specimens of carbon tool steel and tungsten "high-speed" steel examined spontaneously generated a considerable amount of heat at the temperature of the room after being water-hardened at cherry-red or white heat. The development of heat at steadily diminishing rate was observable for more than a month, and was accompanied by a shrinkage in the volume of the steel. Progress of heat generation and of shrinking are shown in curves. But that shrinking is only incident to, and is not the prime cause of, the generation of heat, is evidenced by the fact that the internal work represented by the heat generated is hundreds of times greater than necessary to produce the observed change in volume. In the process of hardening, the steels increased at least $\frac{1}{2}$ per cent. in volume, as shown by specific gravity tests of $\frac{1}{2}$-in. bars and linear measurements of long thin rods. When afterwards tempered to light-blue colour, much shrinkage took place at once, and another large shrinkage when annealed. The author regards the hardened steel as being in a condition of great molecular strain, somewhat unstable at first. Spontaneous relief of a small portion of the strain causes the generation of heat observed until stability at room temperature is reached. Any considerable rise of temperature, as in tempering, permits a further spontaneous relief of strain, or molecular rearrangement, doubtless accompanied by more generation of heat, and so on until annealing temperature

is reached. The process of tempering and annealing steel is exothermic, and conversely hardening is an endothermic process.

Dr. M. H. Jacobs: "Heredity in Protozoa."

In the higher animals, characters are not for the most part directly *transmitted* from one generation to the next, but develop anew in each generation from the germ-plasm. In the protozoa, on the other hand, there is a mixture of direct transmission and new development that has interesting consequences in the case of the inheritance of newly-acquired characters. In this connection a race of Paramecium with three contractile vacuoles instead of the usual number of two is discussed, and the means described by which the unusual number is kept from disappearing. The factors concerned seem to be: (*a*) direct transmission of the extra vacuole; (*b*) a tendency to adhere to ancestral racial traits; and (*c*) a new tendency of the protoplasm to produce extra vacuoles.

Prof. G. H. Parker, Harvard University: "The Problem of Adaptation as Illustrated by the Fur Seals of the Pribilof Islands."

The Alaskan fur-seal is a pelagic animal that breeds in summer on the Pribilof Islands, Behring Sea. About equal numbers of males and females are born. At the breeding age one male, the bull, becomes associated with a number of females, the cows, thus constituting a harem. A harem may contain as many as 120 cows and probably averages about thirty. As a result of this disproportionate relationship as compared with the proportion of the sexes at birth, there are to be found at most breeding grounds many so-called idle bulls. These are a measure of the inefficiency of organic adaptation. Contrary to the opinion held by many biologists, adaptation is not always a relation of great exactitude, but is often, to use the words of Bateson, a poor fit.

Dr. George H. Shull: "Heterosis and the Effects of In-breeding."

Physiological processes are stimulated and rate of growth and total amount of growth increased through the union of gametes having unlike constitution. This physiological effect of the differences in uniting gametes is heterosis. In-breeding lessens heterosis by gradually lessening the differences between the uniting gametes. The application of this principle to some of the problems of practical breeding is discussed.

Prof. Bradley M. Davis, University of Pennsylvania: "The Significance of Sterility in Œnothera."

Studies on the seed, ovule and pollen sterility in Œnothera show that there are species with a high degree of fertility and species in which fertility is low, also that hybrids may exhibit a wide range in comparative fertility. These conditions suggest the possibility that hybrids may at times continue indefinitely as impure, or heterozygous, species through a failure to produce homozygous zygotes, or through the mortality of zygotes having homozygous constitutions. *Œnothera lamarckiana* is a form with low seed fertility and a high degree of pollen and ovule sterility and may be representative of an impure species, hybrid in character, which for the most part breeds true, but occasionally and repeatedly produces other types, the so-called mutants. In genetical work with Œnotheras a method of germinating seeds must be employed which will give trustworthy proof that a culture has produced all the seedlings possible from a sowing of seed-like structures.

Dr. George F. Atkinson: "Morphology and Development of *Agaricus rodmani*."

Agaricus rodmani, which is closely related to the cultivated mushroom, *Agaricus campestris*, has a thick, double annulus, divided into an upper and lower limb by a broad, marginal groove nearly reaching the stem. This annulus, especially the lower limb, has suggested a resemblance to the volva of the Amanitas. While it arises from the surface of the pileus margin, and is composed to some extent of a portion of the blematogen, it is not strictly comparable to the volva, since the blematogen in the species of Amanita thus far studied is separated from the pileus by a distant cleavage layer, while in Agaricus it remains "concrete" with the pileus. The pileus and stem fundaments are differentiated by the appearance of an internal, narrow zone of young, slender hyphæ, rich in protoplasm, the primordium of the hymenophore and pileus margin. These hyphæ are directed obliquely downward. The rapid increase in the elements of this primordium produces a tension on the ground tissue below it, which now lags behind in growth, so that it is torn apart, forming an annular cavity in the angle between the stem and pileus. The pileus margin and the hymenophore primordium increase in a centrifugal direction. The palisade stage of the hymenophore begins next the stem. In certain individuals it also extends partly down on the stem. The hymenophore primordium consists of a zone of parallel, slender hyphæ, the ends of which are not crowded. The transition to the palisade stage occurs by the increase in number of these hyphæ and the broadening of their free ends. The lamellæ originate as radial, downward-growing salients of the palisade zone, beginning next the stem, in some individuals also arising on the upper part of the stem. Since the growth and increase of these parts of the hymenophore, as well as that of the pileus margin, is centrifugal, all stages of the young hymenophore are therefore found in a single individual during an intermediate stage of its development, the zone of gill salients next the stem, followed by the palisade zone, and outside of this the primordial zone.

E. Plaut and M. T. Bogert: "Syringic Acid and its Derivatives."

In the bark and leaves of the lilac (*Syringa vulgaris*), and in the bark of the privet (*Ligustrum vulgare*), there occurs a substance which has been called "syringin," "lilacin," or "ligustrin." When this substance is oxidised with potassium permanganate, it yields glucosyringic acid, and this latter is easily saponified to dextrose and syringic acid. The authors obtained their syringic acid by treating trimethyl gallic acid with fuming sulphuric acid, and have prepared therefrom and studied a number of new derivatives, among them being bromo-, nitro-, amino-, and hydroxy-syringic acids, esters, acetyl derivatives, and ortho-condensation products.

Prof. C. Baskerville. "The Rate of Evaporation of Ether from Oils and its Application in Oil-Ether Colonic Anæsthesia."

The rate of evaporation of oil-ether mixtures containing 25, 50, and 75 per cent. of the latter was determined at the temperature of the body. The oils used were olive, peanut, corn, cottonseed, soya bean, cod liver, and lanolin. The speed at which the ether evaporated from the 75 per cent. mixture was found clinically to be the best for introducing and maintaining anæsthesia in the human body by insertion in the colon. The technique is indicated for operations about the head, mouth, and the buccal cavity. Records are given of more than a thousand cases with different operators without a single case of post-anæsthesia pneumonia and with nausea reduced to the minimum.

Prof. Douglas W. Johnson, Columbia University: "Physiographic Features as a Factor in the European War."

The salient features of geological structure west of the Rhine and the influence of this structure upon surface topography are described. Special attention is given to the Rhine graben and the strong contrast between the steep eastern and gentle western slope of the Vosges; the maturely dissected peneplane of western Germany and the Ardennes, trenched by the incised meandering valleys of the Rhine, Moselle, and Meuse; the concentric cuestas north-east and east of Paris with their steep escarpments facing towards the Germans; and the comparatively level plains of central and north-western Belgium. In the eastern field the East Prussian lake district, the plain of Poland, the Podolian cuesta, and the Carpathian mountains are described. It is shown that in both theatres of war land-forms have exercised an important influence both upon the general plans of campaign and the detailed movements of armies. Topography limited the German invasion of France to four principal routes. The violation of Belgian neutrality had a very distinct topographic basis. Russia's plan of campaign has been dictated in part by topographic considerations, and the principal battles in the east have been fought with reference to natural lines of defence. Suggestions are made as to the effect of land-forms upon probable future movements of the armies.

Prof. Paul Haupt, Johns Hopkins University: "Opium in the Bible."

In ten passages of the Old Testament the Hebrew *rôsh*, head, denotes a bitter and poisonous plant. It is used also of the poison of serpents. According to Pliny the venom of snakes was nothing but bile. The ancients used the same word for gall, bitterness, poison, medicine. We use "to drug" for "to narcotise," although "drug" originally means simply a dry (German *trocken*, Dutch *droog*) herb. *Rôsh* is mentioned in the Bible in connection with *laʿanâh*, wormwood, or absinthe. It was a plant which grew in the furrows of the fields (Hosea x. 4). The Authorised Version renders "hemlock," but *rôsh*, head, denotes poppy-head, and *mê-rôsh* is opium. Also the gall (*i.e.* bitter fluid) with wine (not vinegar) in the account of Christ's crucifixion (Matthew xxvii. 34), and the myrrh in Mark xv. 23 denote opium. The Talmud states that a cup of wine with *lebonâh* was given to criminals before their execution. *Lebonâh* means "incense," as a rule, but in this case it is used for opium. In the fifth chapter of the Third Book of the Maccabees, we read that wine with incense was given to the elephants before they were let loose upon the Jews. This "incense" may have been a preparation of Indian hemp. Assassin means intoxicated with hashish (*Cannabis indica*).

Dr. C. A. Davis: "The Occurrence of Algæ in Carbonaceous Deposits."

On account of their small size and fragile structure, Algæ have not usually been recognised as important contributors to Carbonaceous rocks, and some recent students of the microscopic structure of coals have denied the probability of their existence as fossils in Carbonaceous rocks. Under certain conditions of deposition and preservation, as yet unknown, Algæ may constitute a large percentage of the recognisable plant remains which have accumulated to form beds of Carbonaceous shales of great extent and thickness. Microphotographs of Algæ from the oil-yielding shales of Green River age were described.

Dr. W. J. Sinclair, Princeton University: "Additions to the Fauna of the Lower Pliocene Snake Creek Beds, Nebraska."

The Snake Creek beds explored by the Princeton Expedition of 1914 are found in the north-west corner of Nebraska, and consist of unconsolidated gravels and sands in which water-worn bones of a large number of fossil animals of Lower Pliocene age are found. Most of these remains are fragmentary, and there is almost no association of parts. Better material than has hitherto been collected from this formation has been secured, and new forms are now described for the first time. Most of the remains are of horses, of which there were at least a dozen different species on the Lower Pliocene plains of Nebraska, most of them three-toed. There were also several different kinds of camels, some of them quite large, at least three rhinoceroses, many carnivorous animals, some of large size, at least two mastodons, a peccary, the last of the oreodons or "ruminating hogs," an antelope of entirely new type, quite different from anything hitherto reported from North America, with scimitar-shaped horns sloping backward and curving inward, circular at the base but flattening out toward the tips. There is still another antelope, Dromomeryx, but no trace of the pronghorn. In collections made by the American Museum from the Snake Creek beds the first of the bisons appears, so the Snake Creek fauna gives us some idea of the kinds of animals on the buffalo range when the buffalo first came, and shows what great faunal changes have taken place even during the lifetime of this genus.

Prof. William H. Hobbs, University of Michigan: "The Rôle of the Glacial Anticyclone in the Air Circulation of the Globe."

A theory of nourishment of the great continental glaciers of the polar regions is given, and the author shows in what ways this theory has been confirmed and extended by the work of numerous exploring expeditions. It is because the expeditions across Greenland of 1912 (de Quervain) and of 1913 (Koch and Wegener), and those of Scott and Amundsen into the heart of the Antarctic continent, have for the first time penetrated the central areas of continental glaciers that these studies are illuminating. The penetration of higher levels of the atmosphere upon the borders of the inland-ice through the aid of pilot-balloons has supplied further evidence of great value along a wholly new direction. Most recent of all, the studies of Sir Douglas Mawson within a new section of the Antarctic continental glacier have brought valuable confirmatory observations.

Prof. H. N. Russell, Princeton University: "Note on the Sun's Temperature."

The effective temperature of the sun may be computed from Abbot's data for the radiation of each separate wave-length, using Planck's formula. The resulting temperature at the centre of the disc is about 6600° when determined from the visible radiation, but 600° lower according to the radiation in the infra-red. The effective temperature at the edge of the sun is more than 1000° lower, which accords with the theory that at the centre of the disc we can see down deeper, into hotter layers.

Prof. R. S. Dugan, Princeton University: "Some Results from the Observation of Eclipsing Variables."

Slides were exhibited showing observed light-curves of three giant eclipsing variables: RT Persei, Z Draconis, and RV Ophiuchi; and diagrams of the binary systems the revolution of which is supposed to give rise to the observed light variations. The importance was explained of repeatedly observing the entire period shown in the discovery of shallow secondary minima, the oblateness of the stars, inter-radiation and periastron effects, and darkening towards the limb. Evidence was given of the greater brilliance of the advancing side of the bright star. The variation of the periods of these three stars was described. Early Harvard photographs and recent

photometric observations extend the observations of Z Draconis over nearly 7000 periods and of RT Persei over nearly 11,000 periods. Visual and photographic light-curves were compared.

R. J. McDiarmid: "The Variable Stars TV, TW, and TX Cassiopeiæ."

A brief discussion of the light-curves of the variable stars TV, TW, TX Cassiopeiæ and T Leonis Minoris was given, pointing out interesting features in connection with each system. In the system TV Cass. we have two stars of nearly the same size but of different surface brightness, the ratio being 5·5 to 1·0. In this system other points of interest are brought out, such as the reflection and ellipticity effects. The system TW Cass. represents two stars of almost equal brightness and of nearly the same size, moving in an eccentric orbit. In the third system TX Cass. the two stars are very unequal in size with a ratio of surface brightness of 1·0 to 1·5. The stars are ellipsoidal in shape, giving rise to an ellipticity effect shown by the light-curve. The system is of special interest, as there seems to be little doubt of its being similar to the sun, bright at the centre, decreasing in brightness towards the limb. T Leonis Minoris is an eclipsing variable. The ratio of the surface of the two stars in the eclipsing system T. Leonis Minoris is 1 to 25.

Dr. Edwin B. Frost: "Radial Velocities in the Orion Nebula."

The investigations of the nebula in Orion by Messrs. Bourget, Fabry, and Buisson, of Marseilles, published in the *Astrophysical Journal* for October, 1914, show that the photographic interferometer method can be applied successfully to the study of the radial velocities of the nebula, both as a whole and in its separate parts. Their conclusion that there are appreciable motions in closely adjacent portions of the nebula have been confirmed by observations made recently with the Bruce spectrograph. Differences of more than 10 km. per second in the velocity in the line of sight have been found, and the general effect of rotation of the nebula inferred by the French observers is confirmed by the spectrograph.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The council has decided that in the existing circumstances of national stress the ordinary annual degree congregation with its attendant ceremonial and festivity would be inappropriate. All degrees this year will therefore be granted *in absentia*.

Dr. T. Sydney Short has been appointed Ingleby lecturer for 1916, and Dr. Douglas Stanley has been appointed honorary examiner for the Russell Memorial Prize for the current year.

THE Board of Trinity College, Dublin, has appointed Miss E. M. Maxwell, of the Royal Victoria Eye and Ear Hospital, Dublin, to the Montgomery lectureship in ophthalmology, the establishment of which was announced in NATURE of February 25 last.

WE have received from Washington a copy of the report of the librarian of Congress and of the superintendent of the library building and grounds for the financial year ending June 30, 1914. It is interesting to note that in 1897 the library comprised about 850,000 printed volumes and pamphlets and about 500,000 other articles—manuscripts, maps, and prints; and a staff of forty-two persons. The grants for the purchase of books was 6000*l*. a year, and for printing and binding 5000*l*. At the date of the report the grant for the purchase of books had increased to 20,000*l*., the staff in the library proper was 385, and the number of books had reached two millions, and the other articles another million. In other words, the collection is now in size third among those of the world. We have also received from the Library of Congress a catalogue of the publications issued by the library since 1897.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 3.—Sir William Crookes, president, in the chair.—Prof. C. H. **Lees**: The shapes of the equipotential surfaces in the air near long buildings or walls, and their effect on the measurement of atmospheric potential gradients. The shapes of the equipotential surfaces are determined, and the equipotential lines drawn to scale in the following cases:—(1) A thin vertical wall; (2) a retaining wall separating a lower from a higher horizontal plane; (3) a series of equidistant parallel vertical walls. In each case the normal vertical potential gradient may be calculated from observations of the potential at any point. A point on each wall is indicated at which the horizontal potential gradient is identical with the normal vertical gradient.—Prof. O. W. **Richardson**: The influence of gases on the emission of electrons and ions from hot metals. As is well known, the thermionic saturation current i is expressed accurately and quite generally over wide ranges of temperature by the equation $i = AT^{\frac{1}{2}}e^{-b/T}$. In the case of metals, in particular, the equation is satisfied when the metals are contaminated by the presence of a gaseous atmosphere, as well as when the surfaces of the pure metals are tested. In general, however, the effect of the contaminating gas is to cause large changes in the values of the constants A and b. The changes which are thus brought about in these constants are considered in the present paper. So far as it may be considered trustworthy, the available evidence shows that A and b for a given metal always change together in such a way that the change in $\log A$ is proportional to the change in b. This linear relation is very closely satisfied by the results of all Langmuir's observations with tungsten, for which substance different gases change A by as large a factor as 10^{12}. A similar relation, with an almost equal coefficient of proportionality, is required by the best observations on the negative emission from platinum. In the case of tungsten, contaminants cause an increase in A and b, whereas with platinum a diminution occurs. All the known data point to the existence of a similar law governing the steady emission of positive ions from platinum. By applying thermodynamic considerations to the emission of electrons from contaminated surfaces, it is shown to follow from the linear relation between $\log A$ and b, that the contact potential difference between the pure and the contaminated metal is of the form $a_0(1-\alpha T)$, where the constant a_0 has opposite signs for tungsten and platinum, and α has approximately the same value for both metals. T is the absolute temperature.—Prof. J. W. **Nicholson**: The band spectrum associated with helium. Fowler has concluded recently that the heads of the bands in the new spectrum associated with, and perhaps due to, helium follow laws of the type hitherto peculiar to line-series. A further examination of some points which were in doubt has been made with the following results:—(1) The paper supports the conclusion that the heads of the bands in the spectrum of Goldstein and Curtis follow ordinary series laws by showing that the doublet separations actually tend to zero at the limits of the series; (2) both the doublet

series isolated by Fowler are strictly analogous to principal series in line-spectra; (3) the generalised Rydberg formula, in which the wave number is a function of $m+\mu$, gives the most suitable representation of these series as well as of line-series.—C. **Dobell** and A. P. **Jameson**: The chromosome cycle in Coccidia and Gregarines. The authors have investigated the chromosomes of a coccidian (*Aggregata eberthi*) and a gregarine (*Diplocystis schneideri*). They have found that the chromosomes are present in the haploid ("reduced") number—six in Aggregata, three in Diplocystis—at every nuclear division in the life-history except that of the zygote nucleus. This nucleus contains the diploid number of chromosomes—twelve in Aggregata, six in Diplocystis—and its division is a reduction division which halves the chromosome number. Reduction thus occurs in these organisms immediately after fertilisation, and not during gametogenesis.

Mathematical Society, June 10.—Sir Joseph Larmor, president, in the chair.—Prof. W. **Burnside**: Periodic irrotational waves at the surface of deep water.—Prof. M. **Kuniyeda**: A theorem on series of orthogonal functions.—G. R. **Goldsbrough**: The effect on the tides of the variation in the depth of the sea.—Prof. D. **Buchanan**: Oscillations near an isosceles triangle solution of the problem of three bodies, as the finite masses become unequal.

BOOKS RECEIVED.

The General Theory of Dirichlet's Series. By G. H. Hardy and Dr. M. Riesz. Pp. 78. (Cambridge: At the University Press.) 3*s*. 6*d*. net.

The Soul of the War. By P. Gibbs. Pp. 362. (London: W. Heinemann.) 10*s*. 6*d*. net.

Elementary Experimental Statics. By I. B. Hart. Pp. vii+200. (London: J. M. Dent and Sons, Ltd.) 2*s*. 6*d*.

The People of India. By Sir H. Risley. Second edition. Edited by W. Crooke. Pp. xxxii+472+plates xxxv. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 21*s*. net.

Making the Most of Life. By Prof. M. V. O'Shea and J. H. Kellogg. Pp. ix+298. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

The Statesman's Year-Book, 1915. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. lxxxiv+1536. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Petroleum Technologist's Pocket-Book. By Sir B. Redwood and A. W. Eastlake. Pp. xxiv+454. (London: C. Griffin and Co., Ltd.) 8*s*. 6*d*. net.

Refuse Disposal. By Prof. E. R. Matthews. Pp. xiii+160. (London: C. Griffin and Co., Ltd.) 6*s*. net.

The Tokyo Imperial University Calendar, 1913–14. Pp. vi+349. (Tokyo: Maruya and Co.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 17.

ROYAL SOCIETY, at 4.30.—Analyses of Agricultural Yield. II. The Sowing-date Experiment with Egyptian Cotton, 1913: W. L. Balls and F. S. Holton.—Soil Protozoa and Soil Bacteria: E. J. Russell.—The Enhanced Series of Lines in Spectra of the Alkaline Earths: Prof. W. M. Hicks.—Certain Linear Differential Equations of Astronomical Interest: Prof. H. F. Baker.—The Partial Correlation-Ratio: Prof. Karl Pearson.—The Effect of Temperature on the Hissing of Water when flowing through a Constricted Tube: S. Skinner and F. Entwistle.—Ionisation Potentials of Mercury Cadmium and Zinc and the Single and Many-lined Spectra of these Elements: J. C. McLennan and J. P. Henderson.—A Diagram to Facilitate the Study of External Ballistics: Prof. W. E. Dalby.—The Monoclinic Sulphates containing Ammonium. Completion of the Double Sulphate Series: Dr. A. E. H. Tutton.—And other papers.

LINNEAN SOCIETY, at 5.—Colonel Montagu, Naturalist: Bruce Cummings.—The Fibre of *Calotropis procera*, and the Cultivation of the Plant from an Economic Point of View: Dr. George Henderson.—The Structure of the Rhizopod Test: John Hopkinson.—Medusæ from the Indian Ocean, collected in 1905: E. T. Browne.—Report on the Hexactinellid Sponges (Triaxonida) collected by H.M.S. *Sealark* in the Indian Ocean: Prof. A. Dendy.—The Cephalopoda obtained by the Percy Sladen Trust Expedition to the Indian Ocean in 1905: J. C. Robson.

MONDAY, JUNE 21.

VICTORIA INSTITUTE, at 4.30.—Annual Address: The Unity of Genesis: Prof. H. Edouard Naville.

WEDNESDAY, JUNE 23.

GEOLOGICAL SOCIETY, at 8.—A New Eurypterid from the Belgian Coal Measures: Prof. Xavier Stainier.—A Fossiliferous Limestone from the North Sea: R. B. Newton.—The Origin of the Tin-ore Deposits of Kinta District, Perak (Federated Malay States): W. R. Jones.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY, at 5.—A Theory of the Electrical Resistance of Metals: Sir J. J. Thomson.—An Unbroken Alternating Current for Cable Telegraphy: Lt.-Col. Squier.

CONTENTS.

	PAGE
The Mobilisation of Science	419
Modern Electrical Theory. By **N. B.**	420
Horticulture and Botany	421
Manuals of Physics	423
Evolutionary Medicine. By **R. T. H.**	424
Our Bookshelf	424
Letters to the Editor:—	
Surface Tension and Ferment Action.—**Dr. E. F. Armstrong; Prof. H. E. Armstrong, F.R.S.**	425
Training for Scientific Research.—**Dr. T. S. Patterson**	425
Galileo and the Principle of Similitude.—**Prof. D'Arcy W. Thompson, C.B.**	426
The Names of Physical Units.—**Dr. Ch. Ed. Guillaume; Dr. J. A. Harker, F.R.S.**	427
University Appointments in War Time.—**Prof. Percy F. Frankland, F.R.S.**	428
Volunteers for Scientific Work.—**Edward Heron-Allen**	428
Scientific Methods in Industry. By **W. P. Dreaper**	428
Hampshire Field Archæology. (*Illustrated.*) By **Lieut. W. E. Rolston**	430
Cotton for German Ammunition. By **Sir William Ramsay, K.C.B., F.R.S.**	432
Mr. F. H. Neville, F.R.S.	432
Notes	432
Our Astronomical Column:—	
Behaviour of Spectrum Lines of the Same Series	437
The Fisher, Polk County, Minnesota, Meteorite	437
The Nantucket Maria Mitchell Association	437
Recent Bulletins of the Astronomical Society of France	437
Iron, Carbon, and Phosphorus. By **Prof. H. C. H. Carpenter**	438
The Seismological Society of America. By **Dr. C. Davison**	439
Indian Geodesy. By **H. G. L.**	439
The Fly Problem	440
Jamaica as a Centre for Botanical Research in the Tropics. By **M. D.**	440
The American Philosophical Society	442
University and Educational Intelligence	445
Societies and Academies	445
Books Received	446
Diary of Societies	446

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.